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A Wireless Collision Detection on Transmission Poles through IoT Technology

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Abstract Transmission poles plays a major in the wired telecom communication as well as in the electrical transmission. The wireless communication receivers and antennas are also need poles for holding the antenna and several other peripheral units to its nearby. Most of the transmission poles are kept on the public places for providing a better communication signal and the electric supply. The road side transmission poles are extremely not protected with any safety devices. Those poles are standing on its own strength on the materials used for making the poles. Due to aging and several other factors there are chances for such poles to get damage very easily. Vehicle collision is an important factor in damaging the transmission poles kept near the road side. The proposed method is designed to identify the collision detection on the poles to alert the maintenance team to take immediate action against the faulty poles. It is achieved with the help of IoT technology connecting several peripheral units to a microcontroller.

Keywords: Collision detection, transmission pole safety, vehicle collision, IoT detection.

Introduction

Vehicle collision detection is one of the essential thing in public place to detect the ground truth behind a collision scene. The collision between the vehicles are monitored most of the time by the vehicle owners or by the camera fixed over the vehicle. The public surveillance camera also be helpful in detecting vehicle collision scenes happening in the most crowded area. All such detection cameras and systems are connected with wired communication to such extent only. These visuals won't be available all the time to the collision investigator. There are chances for such systems to be in 'off' position when there is a collision happens. Figure 1 indicates the block diagram of a general camera surveillance system.

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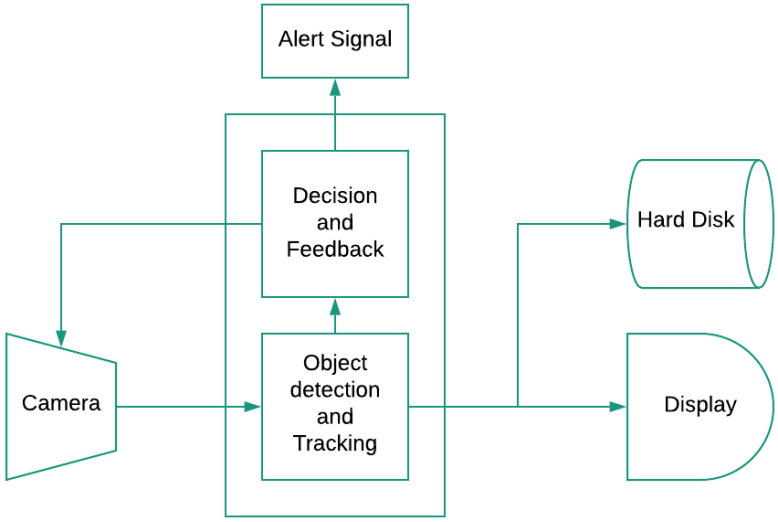

Figure 1. Block diagram of a camera surveillance system.

The camera units are directly connected with a microcontroller in the general surveillance system and it allows the camera to record the video frames continuously for so many hours. The system is designed to stop recording only when the whole system gets off from the supply. Hence it requires a huge hard disk space for storing the recorded video. Some of the recent surveillance systems are comes up with image processing tools to detect the objects and peoples face in the video frames. It helps the camera unit to track the activities of the object to certain extent. These kind of systems are improved with a computer vision algorithm to give alert signal when there is an unusual activity.

The only drawback in such kind of surveillance systems are the factor of costs. The costs will be usually high when there is more number peripheral devices to connect the microcontroller. The maintenance of such systems are also required to be high. Hence a new kind of surveillance system is proposed in this work based on IoT technology. The IoT technology is a growing up technology for wireless remote transmission data from one place to another place. The data which are transmitted through IoT platform are generally stored in the cloud space. Hence the cost amount requirement for installing such applications and systems have become very low when comparing to the existing design system. The reliability and security of the IoT platform and cloud storage is also good when comparing to the local hard disk. The data which are stored in cloud storage which are also be accessible from any other place apart from the source station, hence it improves the feasibility of the surveillance system.

Apart from image processing and computer vision tools, the low cost sensors are cheaper in price to detect the collision or accident presence in a place. These kind of sensors are employed in the proposed work as a switching devices to enable the surveillance system to operate on certain specify time alone. Therefore the overall cost of the proposed system gets reduced when it is connected over the existing systems. The merits of the IoT based surveillance systems are listed below.

- The IoT system requires very less amount of energy for its operations.
- It can avoid physical monitoring of display when it is adapted with an intelligent algorithm structure.
- The data can be retrieved from anywhere from the source station.
- The number of systems and display units can be increased depending upon the requirement.
- It provides very huge area of memory storage.

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- The system has very good adaptability with the peripheral devices as it does not connected with any storage unit.

When it comes to the application of collision detection, the proposed model is employed with an IoT architecture for transmitting the collected data. Therefore the possibility of installation place of the collision detection system is improved. In the proposed work the detection system is connected over the transmission poles of collision suspected area to visualize the place when there is a need. As it does not requires any huge hard disk in the place, the system can be fixed at any location. The power requirement of such systems are usually very low, hence it can be collected from the signals of the transmission lines.

Related work

An internet of vehicle based technology on deep learning methods [1] was developed to analyze the collision detection for a vehicle with the help of sensor and camera place in a vehicle. The design was made to analyze the collision detection and send the appropriate signal to the cloud platform for alerting the required rescue station based on the predicted location of the collision identified by the proposed algorithm. The action time of seven seconds was verified in the algorithm in collision detection with 96% of accuracy. The artificial intelligence based algorithms plays a better role in safety of the self-driving cars [2]. The self-driving cars are always connected with more number of sensors from the usual driving cars. In the general cars the sensors are connected to just monitor the environment conditions for blockage detection. The output of the sensors are made to give alert signal to the driver. But in self-driving cars the algorithm has to control the vehicle movement according to the received sensor signals. Hence these algorithm have to be highly accurate in operation as well as must have to capability to react in very faster manner. The conflicts of the intelligent vehicles were analyzed to improve the reliability of the intelligent vehicles [3]. The experiment was analyzed with so many research article with their technologies. The experiment indicates that the present scenario technologies feel difficulty during an overtake and lane changing condition. A combination of intelligent algorithm along with vehicle to vehicle communication avoids such collision in critical conditions.

The computer vision based technologies are growing up in enabling the vehicles safety on several conditions [4]. The computer vision algorithms has the ability to predict the objects comes in front of the fixed camera. The deep learning algorithm burned inside such microcontrollers operates the camera to visualize the scene for tracking the objects. The objects are detected by training the algorithms to memorize the features of a scene or object. These kind of algorithms are enabled as representing the neurons of the human brain. Hence the learning capacity of the deep learning algorithms are growing up to its extent to segregate the objects with its features. The only drawback in computer vision algorithms are its cost. Cost wise these kind of algorithms are very high when comparing with the sensor technology. An IoT based accident detection system [5] was developed to locate the accident place with the help of different kind of sensors. The sensors are connected to measure the pressure applied to the vehicle to measure the collision. Similarly, the location point is also gathered with the help of GPS system to send the location details. A microphone is employed in the system to record the voice and sound of the accident happening area to forward the message to a destination helper to understand the situation. All such informations are forwarded through IoT architecture to the emergency care unit. The collected informations are also moved to the cloud storage for analyzing the condition of the accident in the future.

A traffic sign sensing system [6] based on computer vision technology was proposed to understand the situation of the road signal for self-driving cars. These algorithm utilizes a camera unit for capturing the roadways continuously throughout the journey and the observed vision signal and scenes are transmitted to the microcontroller unit. The microcontroller analyzes the scene in the real-time condition with the help of deep learning algorithm programmed in it. An intrusion detection system [7] was developed to detect the spoofing kind of attacks in the electric vehicles. The electric vehicles are tried to be in contact with the neighboring cars for several features sharing. Most of the time these kind of communication helps in preventing vehicle collision. Anyhow the signal transmitted between

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the vehicles are need to be secured for avoid several kind of intrusions. A machine learning technique was employed here with intrusion detection system to find the spoofing kind of attacks on the vehicle communication. The deep learning algorithms are generally helpful in classifying the objects based on its feature extraction during the training process [8]. Apart from classification these algorithms are helpful in predicting the conditions for transmitting the required signals to the receiver station. There are several types of deep learning algorithms are available in the network theory. An appropriate technique has to be chosen for the right application.

An advanced anti-collision system was designed to avoid vehicle and obstacle collision in real time applications [9]. The system utilizes GPS and Zigbee protocol for location prediction and signal transmission process. The communication between the vehicles are positively can happen through Zigbee methodology. The location of the vehicles can be easily predicted by the GPS system for analyzing the traffic level of the roads. In the proposed method the microcontroller system is connected to the ABS unit of the vehicle to apply braking force when there is an obstacle on the road. The IoT systems are helpful in sharing the gathered informations from one place to another place [10]. A group of sensors connected in a greenhouse environment for observing the field condition in a better way. The observed signal values are transmitted to a remote destination for analyzing the conditions of the greenhouse field. The IoT systems has the ability to send multiple signals at a same time to the receiver. Due to the adaptability of the recent trend microcontrollers, it is possible to connect all the peripheral units in a single block unit. Hence the size of the unit is reduced with better performance rate. A collision risk estimation system was designed to predict the road conditions from the performance of the vehicle going in front of the source vehicle [11]. The system gives excellent prediction with the help of vehicle to vehicle communication and lane detection algorithm.

In IoT transmission, the data which are transmitted through IoT network has to be secured from getting damage or loss of information. The blockchain technology is a recent technology used to segregate the informations received from the IoT transmission in cloud storage [12]. It improves the accessing speed of the records which are saved in the cloud environment. The number of data which are transmitted from the IoT devices requires huge set of storage unit. This happens because of the continuous monitoring of the field through the connected sensors. The complexity in sending the collected information on vehicle collision detection system is to send the required informations. The general vehicle collision system monitors the pedestrian detection, vehicle to vehicle communication and road signal detection [13]. Hence a monitoring system is needed to segregate the useful informations from the collected data for storing in the cloud or blockchain environment. Usually in cloud computing environment, it is always faster when the IoT data are stored with a blockchain environment. The data which are collected from healthcare department of a hospital may have long list of reports regarding the patient health and personal records [14]. In blockchain the reports are segregated to make it feasible for further analysis process. A rear end collision avoidance system [15] was proposed to monitor the activity of the ongoing vehicle. A fully distributed beacon system was employed in the system to monitor the activity in an efficient way.

Proposed work

The transmission poles are usually be in two types. One type is made up of metals and the other type is made up of cement concrete. Both of these kind of poles are comes up with different heights for transmitting the electricity wires and other signal lines. As these transmission poles are kept over the roadside place, it has more chance for getting affected with small and huge vehicle collision. During such condition the transmission poles were kept as it is with the damage part to continue its service. There is no separate module as of now for monitoring the status of the transmission poles. Most of the time the damages are found only by physical verification of the maintenance staff. Very rarely the person who made the accident or general public conveys the damage condition of the transmission pole to the maintenance team. The transmission poles are widely used to transmit the signals and electric supply foe very long distance. Hence there is no way to monitor such transmission poles placed far away in a highway roads and

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forest area. The transmission poles are also have the chances for getting damage due to aging and several natural disasters also makes trouble to the transmission poles health condition.

The proposed work detects vehicle collision and other kind of collision over a transmission pole with the help of IoT technology for information sharing. Figure 2 indicates the basic architecture of the proposed work. Here a microcontroller is placed over a transmission pole with sensors, camera and transmitter unit for monitoring the strength condition of a transmission pole. The sensors which are placed in the transmission pole are designed to detect vibrations and cracks over the transmission pole. At the same time a camera module has been connected to the microcontroller for capturing the transmission pole surroundings during the emergency condition.

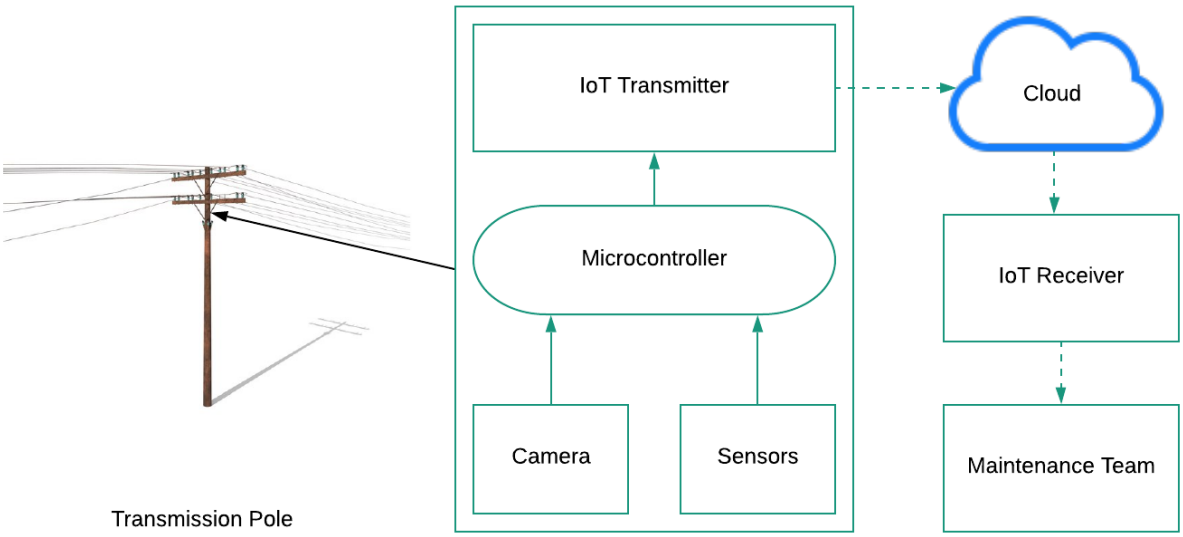

Figure 2. Architecture of the proposed collision system.

A SW-420 vibration sensor was employed in the proposed work for observing the vibrations from the transmission poles during emergency condition. The vibration sensors can be kept inside a cement concrete through lengthy wires for connecting it with the microcontroller. In order to improve the efficiency of the system the number of vibration sensors connected with the transmission poles can be increased. For metal kind of poles there will be a hollow space inside every poles, hence the vibration sensors can be placed inside the hollow space for detecting the vibrations. The vibration signal generated from the sensors are transmitted to the microcontroller as electrical signal for reading the condition of the transmission pole.

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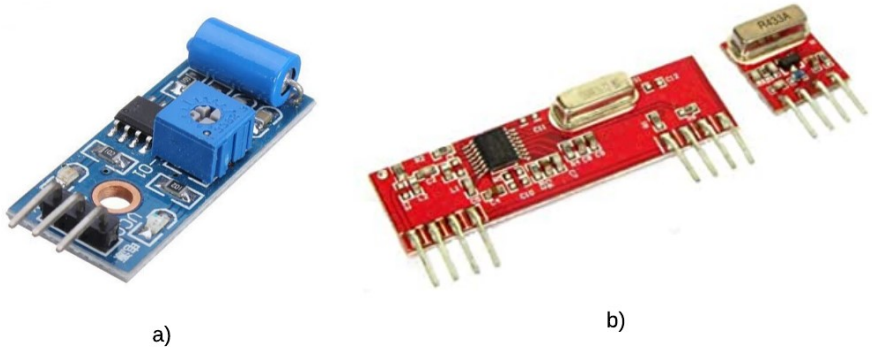

Figure 3 (a) Vibration sensor (b) Transmitter.

The microcontroller sends a message signal to the camera module when the trigger value of the vibration sensor is attained due to any kind of collision. At that time the camera is programed to capture one snapshot of the transmission pole surrounding for understanding the reason of the vibration. Most of the time transmission poles are getting damaged due to vehicle collision only. But the vehicles which made damage to the transmission poles are not usually traceable in the real time situation for collecting fine for the damage. The proposed work aims to avoid such condition by taking a snapshot of the location for immediate after the collision. Hence there is a chance for identifying the vehicle information. The proposed work is also designed to send the location and time of the collision occurs. Therefore the system allows the maintenance team to locate the transmission pole fault immediately. This improves the quality of the transmission system and it protects the environment from severe damage or accident. In order to make the IoT transmission an IoT 433 MHz transmitter module was connected with the microcontroller. It enables the collected information to transmit to the desired location for information sharing. The informations are forwarded to a cloud storage for storing the data information. The informations are further forwarded to a receiver station through wireless medium. There are several IoT providers are available in the market for transmitting the necessary information all over the world. The system employs one such network for connecting an android device to the network server.

The major challenge of the proposed work is camera fixation. The camera has to cover the whole area near the transmission pole for avoiding the blind spot. An OV2640 camera module was employed in this work for covering the maximum area space. The information loss is yet another drawback of such kind of system. A very good transmission signal strength allows the IoT data to move over to the cloud space. The proposed module of microcontroller, camera and transmitter units are need to be placed over the transmission pole to its maximum height position for saving the module from physical damage during collision. The fixation of vibration sensor can be challengeable when it comes to faulty condition. The system can also be used for visual surveillance of the connected area during any other emergency situations.

Results and Discussion

The performance of the proposed system is mainly depends upon the reliability of the peripheral unit connected to the microcontroller. Hence it has been verified by conducting a prototype experiment by connecting the vibration sensor with an arduino microcontroller. A LED light was connected to the output side of the microcontroller for detecting the output threshold of the vibration sensor. The microcontroller was programmed to enable the LED light pin when it crosses the threshold value given for the vibration sensor. A 10K potentiometer will be there in the vibration sensor unit for adjusting the threshold value. The output of the vibration sensor is a digital one for enabling

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the camera unit for capturing the scene. Figure 4 indicates the threshold operation of the vibration sensor. Similarly figure 5 indicates the measured threshold value from the vibration sensor.

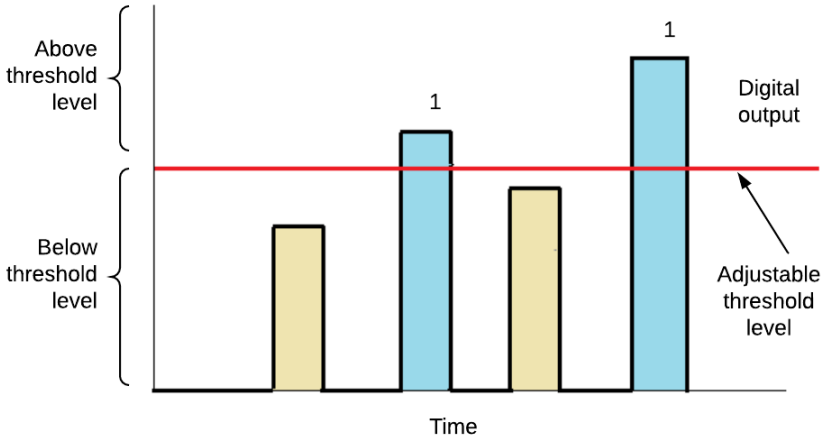

Figure 4. Output performance of the vibration sensor.

The output pin of the vibration sensor has to be connected with the PWM pin of the microcontroller to observe the changes. The changes may not be observable when the output pin is directly connected with the digital pins of the microcontroller. The microcontroller has to be programmed for enabling some digital output pin for calibrating the threshold level for the needed vibration. At such time the digital put and the serial monitor output has to be monitored by the programmer. The proposed system can be taken for the real time work when the trigger values are rightly adjusted.

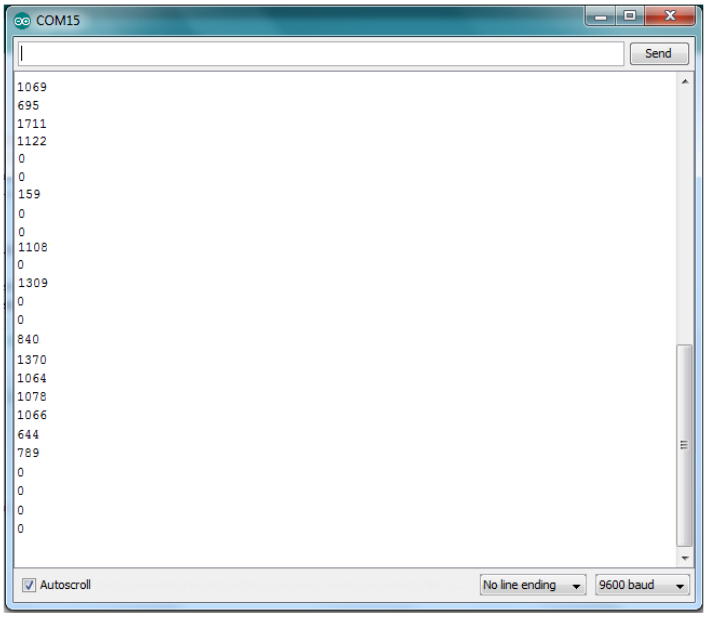

Figure 5. Vibration sensor output on serial monitor.

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Conclusion and future scope

The proposed wireless collision detection system has been developed to monitor the physical collision instance on transmission poles. The model is employed with a vibration sensor for observing the vibrations into digital form and a microcontroller unit is employed for reading the digital values and connecting with other peripheral devices. The IoT transmitter and a camera unit are the other two peripheral units which is presented to share the collected informations along with a real time photo shot of the location. The performance of the proposed work has been verified with a prototype where several challenges were met in the operations. The major performance limitation of the proposed work is about the efficiency of the IoT transmission signal. The work can be taken for real time operation when such drawbacks are rectified by an intelligent controller unit. Similarly the model has been developed without an image processing algorithm. The work can be extended with a real time image processing algorithm for extracting the useful informations from the taken image.

References

1. Chang, Wan-Jung, Liang-Bi Chen, and Ke-Yu Su. "DeepCrash: A Deep Learning-Based Internet of Vehicles System for Head-On and Single-Vehicle Accident Detection With Emergency Notification." IEEE Access 7 (2019): 148163-148175.
2. Manoharan, Samuel. "An improved safety algorithm for artificial intelligence enabled processors in self driving cars." Journal of Artificial Intelligence 1, no. 02 (2019): 95-104.
3. Hu, Lin, Jian Ou, Jing Huang, Yimin Chen, and Dongpu Cao. "A review of research on traffic conflicts based on intelligent vehicles." IEEE Access 8 (2020): 24471-24483.
4. Suma, V. "Computer Vision for Human-Machine Interaction-Review." Journal of trends in Computer Science and Smart technology (TCSST) 1, no. 02 (2019): 131-139.
5. Bhatti, Fizzah, Munam Ali Shah, Carsten Maple, and Saif Ul Islam. "A novel internet of things-enabled accident detection and reporting system for smart city environments." Sensors 19, no. 9 (2019): 2071.
6. Koresh, M. H. J. D., and J. Deva. "Computer vision based traffic sign sensing for smart transport." Journal of Innovative Image Processing (JIIP) 1, no. 01 (2019): 11-19.
7. Kosmanos, Dimitrios, Apostolos Pappas, Leandros Maglaras, Sotiris Moschoyiannis, Francisco J. Aparicio-Navarro, Antonios Argyriou, and Helge Janicke. "A novel Intrusion Detection System against spoofing attacks in connected Electric Vehicles." Array 5 (2020): 100013.
8. Bashar, Abul. "Survey on evolving deep learning neural network architectures." Journal of Artificial Intelligence 1, no. 02 (2019): 73-82.
9. Patnayak, Satyajeet, Anisha Swain, and Manaswini Das. "Advance Anti-collision Device for Vehicles Using GPS and Zigbee." In Innovations in Soft Computing and Information Technology, pp. 117-123. Springer, Singapore, 2019.
10. Raj, Jennifer S., and J. Vijitha Ananthi. "Automation using IoT in greenhouse environment." Journal of Information Technology 1, no. 01 (2019): 38-47.
11. Chen, Junlan, Ke Wang, Huanhuan Bao, and Tao Chen. "A Design of Cooperative Overtaking Based on Complex Lane Detection and Collision Risk Estimation." IEEE Access 7 (2019): 87951-87959.
12. Wang, Haoxiang. "IoT based Clinical Sensor Data Management and Transfer using Blockchain Technology." Journal of ISMAC 2, no. 03 (2020): 154-159.
13. Elliott, David, Walter Keen, and Lei Miao. "Recent advances in connected and automated vehicles." Journal of Traffic and Transportation Engineering (English Edition) 6, no. 2 (2019): 109-131.
14. Smys, S., and Jennifer S. Raj. "Internet of things and big data analytics for health care with cloud computing." Journal of Information Technology 1, no. 01 (2019): 9-18.
15. Lyu, Feng, Nan Cheng, Hongzi Zhu, Haibo Zhou, Wenchao Xu, Minglu Li, and Xuemin Shen. "Towards rear-end collision avoidance: Adaptive beaconing for connected vehicles." IEEE Transactions on Intelligent Transportation Systems (2020).

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