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# Future of Self-driving Vehicle using Data Analytics and Edge Computing with 5G

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***Abstract*— Governments in various countries are focusing on mandating various advanced driver assisting systems (ADAS) and safety features. New technological innovations in the field of the communication is accelerating at a fast rate. This paper demonstrates Self driving cars using emerging technology, a self-driving vehicle with a reality soon using 5G ,Edge computing and data analytics, this will be an evolutionary step in reducing numbers of road accidents .**

***Keywords—ADAS, 5G, Edge computing, DSRC, LTE,4G***

***Introduction and history***

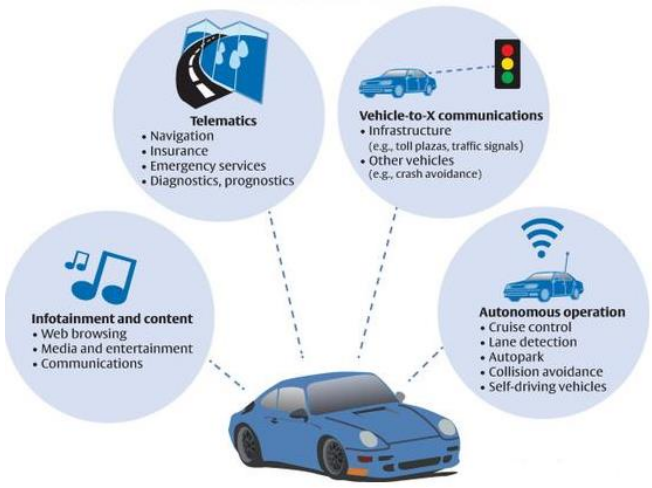


*Figure 1. Evolution of Car and Telecommunication*

In the summer of 2014, Audi was the first automaker to offer the 4G/LTE Wi-Fi Hotspots access and the first mass deployment of 4G/LTE was by General Motors.

In 2017, European technology start-up Stratio Automotive provided over 10,000 vehicles with predictive intelligence enabling fleet operators to better manage and maintain their vehicles.

*Figure 2: Self driving Technology*

In telecommunications, 5G is the fifth-generation technology standard for broadband cellular networks, where cellular phone companies began deploying worldwide in 2019 and is the planned successor to the 4G networks which provide connectivity to most current cellphones. 5G networks are predicted to have more than 1.7 billion subscribers worldwide by 2025.

Using 5G and data analytics with self-driving vehicles will be reality very soon, this paper gives some brief practical views of self-driving technology in the future.

Over the past several years, inter-vehicle communication has received a lot of interest, especially in the context of safety, where it has been subject to a significant amount of research. It is now fairly well-recognized that inter-vehicle communication could potentially help in the reduction of traffic-related fatalities, which over 37,000 occurred on the US roads in 2016, according to data from the U.S. Department of Transportation's National Highway Traffic Safety Administration.

***Things needed to make self-driving possible***

- A forward-facing radar
- Cameras
- Cameras that provide visibility up to 250 meters away
- A high-precision digitally controlled electric assisted braking system
- 12 long-range ultrasonic sensors around the vehicle
- These sensors can be affected if there is debris covering them
- Sensing everything within 16 feet away from the vehicle

***Self-driving evolution***

The radar and forward-facing cameras track the position of vehicles ahead and adjust the vehicle's speed accordingly. This feature maintains a safe distance between you and the vehicle in front. The distance between the vehicles depends on the speed both vehicles are traveling. If a vehicle merges into your lane, the vehicle will monitor its position and reduce speed if necessary. The Vehicle will not panic and slam on the brakes if a vehicle merges in your lane and accelerates.

The autosteer function lets the Vehicle stay at the lane properly, change lanes, and self-park. To keep the Vehicle at the proper lane, the cameras around the vehicle track the position of all the road markings and the sensors monitor other vehicles on the road to keep a safe distance.

***Evolutionary Approach***

As explained above, modern vehicles have many technological devices used to collect real-time data This data is enough to control the vehicle.

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The most challenging part is controlling the vehicle in speed, when vehicle speed increases, controlling the vehicle becomes more challenging.

This paper explains the usage of the new modern communication and computing technologies which can be used to control the vehicle at high speeds.

Considering an example of the USA California DMV, the maximum speed limit on most California highways is 65 mph. You may drive 70 mph where allowed, Vehicle speed would be around 109.990ft/Second

5G cellular speeds tops at about 10 gigabytes per second (Gbps).
In every 100ft every vehicle could transfer all the road conditions data to "Mobile Edge Computing Centre" (MECC) using 5G cellular technology.

Vehicle would send the driving coordinates and the real time sensor data to MECC, then the MECC would also get the vehicle navigation reference from the cloud, this data shall be used by MECC to get to the next 100ft of its further driving direction.

Data analytics is the science of analysing raw data sent from all the vehicles and Image maps in order to make conclusions about that information. Many of the techniques and processes of data analytics will be automated into mechanical processes and algorithms to predict the next possible safe speed for the all the vehicles. This control information will be sent back to all the vehicles to adjust the speed.

As shown in the following picture

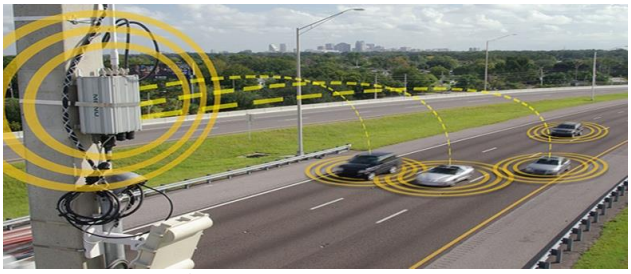

*Figure 3: Diagram of the driverless vehicle system using proposed approach*

Every vehicle shall communicate to a reachable MECC or to the nearest vehicle for all the computed information.
The Navigation information will be used by the edge to guide all other vehicles on that route to maintain the speed.
Every second, all the vehicles connected to this network on the road will get the information to safe speed.

In the example below, every vehicle is connected to the cloud with the navigation system. This navigation system will provide the route information to the connected MECC,
all MECC's are connected to central cloud and transfer data.
Central cloud shall communicate upcoming vehicles navigation route to all the cluster MECC on that route, so all the MECCs has the information about all the vehicles which are going to pass on that road.
The MECC will keep broadcasting the real time driving data to all the vehicles connected to the grid relevant to the particular route.

***The information below is based on the picture presentation shown below***

If vehicle 1 is going at a certain speed and it drastically reduces the speed due to some sudden changes, this information is passed to MECC, MECC shall broadcast this information to all the MECCs on that route. Vehicle 2 will adjust and all the vehicles on that route will gradually adjust the speed as per the real feedback. The speed of 5G and edge computing helps to reduce the latency and makes this information available at the real time, which in turn helps in reducing the possible accidents and averts the traffic congestion.

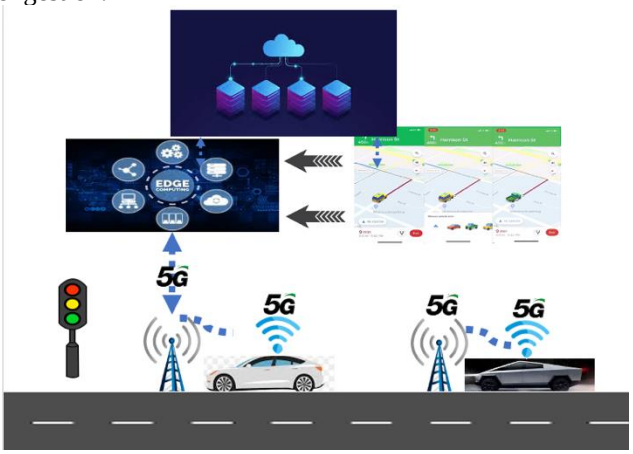


*Figure 4: Self driving with future road condition predication*

## ABBREVIATIONS & ACRONYMS:

5G – Fifth Generation
4G – Fourth Generation
ADAS – Advanced driver assistance systems
DSRC - Dedicated short-range communication
LTE – Long Term Evolution

## CONCLUSION

Edge computing thrives in moving the major computing resources to the edge of the network, reversing the process of centralization and working with more distributed network. Computing is done at or near the source of the data, instead of relying on the cloud a few milliseconds of delay can result in a crash. Self-driving vehicles need to react immediately to changing road conditions and they cannot afford to wait for instructions or recommendations from a distant Cloud server. The solution to this problem is offered by edge computing and 5G. The combination of the Edge computing and 5G is going the define the future of the self-driving vehicles.

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