The Study of Self Driven Cars With Special Reference to Google Drive And Maruti Celerio In High Speed Internet Connectivity

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Abstract : The automobile industries in india growing very rapidly. Nowadays automobile companies are working on self drive car but the indian roads not compatable to driven self driving car on the roads therefore new aerodrive celerio self driving car is the best solution to overcome this problem. Maruti Celerio self driving car is totally made up wires and automatic features. It is a crude feature. In India it is developed by small startup called fisheyebox is the first. The basic concept of car is self drive and work by computer system/ features , with the help of camera, sensor , radar , electricity. This self drive car is have a very important feature. It is work on renewable source , it is not harmfull / distory nature. In this paper the author(s) firstly, introduce about the new indian aerodrive celerio self driving car. Secondly, we will discuss about what kind of technologies used in this car. In this paper we will cdalso discuss about indian roads and comparison between google drive car and new indian aerodrive celerio self driving car. In this paper we will also discussed about communication technologies like V2V and V2I and for the better communication how 5G will support for the self driving cars.

Keywords: Maruti Celerio Self Driving car, new Aerodrive, fisheyebox, Waymo, V2V/V2I communication, 5G communication, Indian roads

I. INTRODUCTION

The automobile industries in india growing very rapidly. Nowadays automobile companies are working on self drive car. Currently, Maruti Celerio and Google drive car "Waymo" hit on the road. A fun fact is most of the cars currently at the sale in Indian auto market come from foreign makers like :Honda, Suzuki, BMW, Hyundai, Fiat, Chevrolet etc. and the list goes on. Many automobile companies as well as technical companies have joined efforts to make the revolutionary change to build self driving cars. These types of cars captured our imagination. These cars build with special sensors and powerful onboard computers to drive. Many types of advance technologies used to make these types of car like machine learning, LIDAR, radar, computer vision, and real-time computational power, software etc. Nowadays, in India many automobile companies are working on self drive car.

As the times are charging, apart from making a mark in other fields, India is showing some significant growth. Joining the chorus of making driverless or autonomous cars, a small start-up in Kolkata has taken the first step in making self-driving cars a reality. Even though the concept, of a car without a driver is already being tested by Google and many more, the theory of 'better late than never' works for India. Latest example of great success of self drive car is Maruti Celerio. Maruti Celerio self drive car is an Indian car which is developed in out of India and converted in self drive car. It is work on every place but in India is not work on Indian road because so many trubles in road . not proper flate road so maruti celerio is not work now but as soon work on it. To overcome this problem new aerodrive celerio self drive car is the first step into the new world of autonomous cars. This is made possible by a company name Fisheyebox, a tech startup of just six people, to drive what they claimed to be India's first self-driving car and they called this project a AERODRIVE and they not only made India's first driver less car and they have possibly made world's cheapest driver less car under a budget of RS. 20 lakhs [1].

Therefore, this paper introduce about the new indian aerodrive celerio self driving car and what kind of technologies used in this car. In this paper we will also discuss about indian roads and comparison between google drive car and new indian aerodrive celerio self driving car. And how the communication technlogies will support to million of self driving cars in near future.

II. SELF DRIVING CAR TECHNOLOGIES

The technologies on which many of the automobile industries are working to make to make the revolutionary change to build self drive car. These self drive cars can be captured our imagination. These cars build with special sensors and powerful onboard computers to drive. Sensors are used to collect the information about the outside area. The data collected by the sensors is fed to high speed computers who turn it into digital maps that are then used to guide the car along its path. Many types of advance technologies and sensors are normally incorporated into self drive cars such as

machine learning, LIDAR, radar, computer vision, and real-time computational power, software etc.
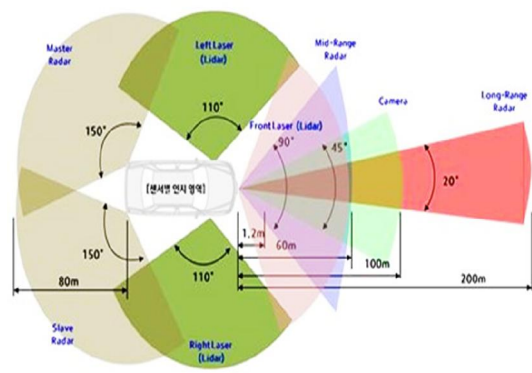

Image 1: showing the various technologies in self driving vehicles

Source: https://gas2.org/2017/11/14/lidar-necessary-fully-autonomous-vehicles/

1. Image Recognition for Self-Driving cars

With the help of Image recognition technology, the self driving car could understanding of the environmental condition such as traffic lights, brake lights, turn signals and see the indicator. Image recognition is divided into two categories: machine vision and computer vision

(i) Machine vision is the technology that can be identified the objects such as pedestrians, other cars, lane markings and the edges,corners of the road.

(ii) Computer vision is used to requires illumination and must deal with light variation. It is used to figuring out what that object is and discerning details about it. It is also essential for reading signs, particularly temporary signs for things like construction and detours that cannot be fed into a database the way a stop sign can. Computer vision is the much harder problem of recognizing objects and understanding what they are doing. The way this currently works is through machine learning techniques in which a large training set can be used to teach an AI to recognize and understand something [2].

2. LIDAR

LIDAR stands for Light Detection and Ranging. *It* is a remote sensing method that uses light in the form of a pulsed laser to measure ranges to the Earth. LIDAR is ideal for mapping an environment, determining that an object is present and figuring out what it is doing. It uses laser beams to generate a 360-degree image of the car's surroundings.

3. RADAR SENSORS

Measure the distance from the car to obstacles. The car's sensors gather data on nearby objects, like their size and rate of speed. It categorizes the objects as cyclists, pedestrians or other cars and objects based on how they are likely to behave.

4. Cameras

Uses parallax from multiple images to find the distance to various objects. Cameras also detect traffic lights and signs, and help recognize moving objects like pedestrians and bicyclists

5. Need of powerful computers

The data processing in self driven vehicle is necessary for image recognition, LIDAR, radar, Laser and more in fractions of a few second. For this purpose much more powerful computers will required in future. It is located in trunk of the car and analyzes data from the sensors, and compares its stored maps to assess current conditions.

6. Adaptive Cruise Control

It is a system for self drive cars, which refers that automatically adjusts the speed of vehicle to maintain a safe distance from vehicles ahead. This system will automatically control the speed of the self driven vehicle. Mainly,the ACC systems are based on either LASER, RADAR, Optical based.

Most of the automobile industries uses the LASER and RADAR system and mounted to the front of the self drive vehicle. It can be used to measure the gap between two vehicles. This data can be used to adjust the speed automatically between two vehicles.
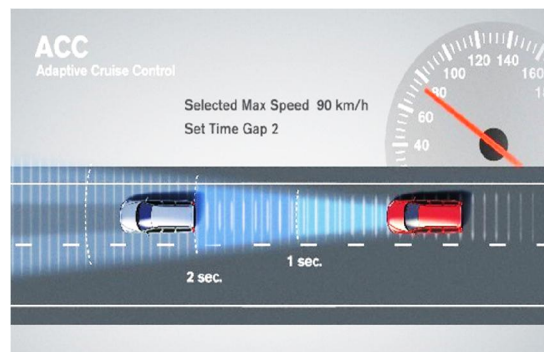

Image 2: showing the Adaptive cruise control continually adjusts the gap between vehicles based on your speed to ensure sufficient time to react. (Image courtesy of Volvo.)
Source:https://www.engineering.com/DesignerEdge/DesignerEdge Articles/ArticleID/13270/What-Tech-Will-it-Take-to-Put-Self-Driving-Cars-on-the-Road.aspx

III. MARUTI CELERIO SELF DRIVE CAR

Maruti Celerio Self Drive Car is a very sweet car it's look like Google Drive Car. The both car is one feature is same self drive. Maruti Celerio self drive car is a Indian car which is developed in out of Indian and converted in self drive car. It is work on every place but in India is not work on Indian road because so many trubles in road, not proper flate road so maruti celerio is not work now but as soon work on it .

III.I. THE NEW INDIAN AERODRIVE CELERIO SELF DRIVING CAR

Fisheyebox's Project Aerodrive is the first step into the new world of autonomous cars. They have converted a Maruti Celerio into a rudimentary autonomous car with a Rs.20 lakh budget and are looking for an investment to go to the next level.

Image 3: showing the picture of new Aerodrive celerio

Source:https://www.autocarindia.com/auto-features/taken-for-a-drive-in-a-self-driving-celerio-405883

Aerodrive has a voice recognition software which fires the K10 engine with a 'START ENGINE' voice command. There is no steering wheel in the car. A $2000 joystick is used to engage autonomous driving mode by pulling back and toggling a switch to select the autonomous mode. Aerodrive has a limited speed to 25kph as doesn't have the capability to stop. It also has a manual mode. Push and pull movements of the super-sensitive joystick are to accelerate and brake, while side movements steer the vehicle. The Aerodrive Celerio navigates itself quite easily and precisely. It also has Pedestrian Detection Control (PDC) [3]. With the help of PDC if any object like dog , cattle , person or any vehicle etc. comes in front of the car, then the camera will detect the object and send the signal to the CPU and then car stop.

IV. COMPARISION BETWEEN GOOGLE AUTOMATIC CAR AND MARUTI CELERIO

Currently the google introduce the self driving car named "Waymo". Waymo's system has vision modules using multiple sensors, and an additional forward-facing super high resolution multi-sensor module that provides a 360-degree view. This allows the system to detect small objects, even in the dark or in harsh sunlight or glare. Waymo self-driving cars now have three LiDAR. The company has been using medium-range LiDAR, which is located on top of the car [4].

This self-driving cars are equipped with cameras, radars, and LiDAR. Different type of equipment are used in google drive car like ;

(1) On the top of car LiDARs (light detection and ranging) .
(2) front (video cameras)

(3) Downward of front light (radar sensors)

(4) Central computer

(5) On wheel odometry sensors

(6) Out side the gate of car ultrasonic sensors are attached

(7) A antenna is placed back side of car which is called GPS (global positioning system)

(8) On backside of car mirror Rear camera is connected etc..

Google Drive Car is work in market any condition like ; rain , desart , winter, snow etc.

The cost of LiDAR is very expensive. A single top-of-the-range LiDAR costs more than $75,000, according to Waymo. Because in "Waymo" the equipment and technologies are so expensive ,it's the reason that this car is too expensive for the individual customer.
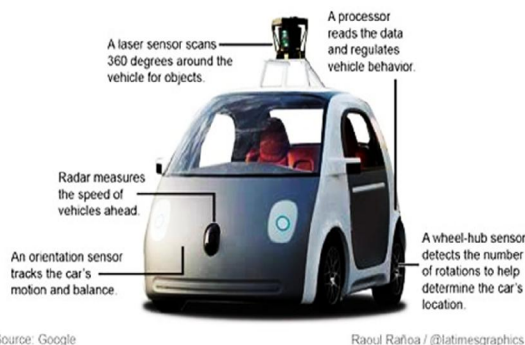

Image 4:showing the technologies used in Google's drive car "Waymo"
Source:https://www.bing.com/images/search?view=detailV2&ccid=H4DAgENO&id=3EE641DF53A8637508048B8260968D7239E87C5E&thid=OIP.H4DAgENOob80xEVlQLrD0QHaEK&q=google+self+drive+car&simid=608016909766101552&selectedIndex=12&ajaxhist=0

But in Aerodrive Celerio the navigation system will automatically navigates the lanes and makes the passengers reach to their destination. It uses Pedestrian detection control that enables the protection to the passengers and even the people on the road. The CPU, it is the brain of self driven car provides the command to the car for operating various functions and along with the other inputs installed inside the car. Ti also uses Inertial Measuring unit (IMU) which helps for providing the locations with the help of GPS , the gyroscope that helps in measuring and maintaing the rotation of the wheel and the accelerometer.

Camera also uses that senses the surroundings which is alike a normal camera of 720x 1080 px forward spacing camera.

It is equipped with Lidar system that allows the car to easily sense the environment in 3D [5]. This is the cheapest Indian self driving car working with auto pilot mode specially designed for Indian citizens. The cost of this car is cheapest only 20 lakhs it's the reason that any individual customer can afford this car to enjoy the self driving car's facility in future .

V. IS INDIAN ROADS ARE COMPATABLE FOR SELF DRIVEN CARS ?

Indian road condition is very critical and unsuitable for automatic vehicles. Many problems are in specially in rainy session by heavy rain road are fully full by the rain water and create holes on the road vehicles are trip and faces undesirable problems. Some rough roads are in village. In those conditions automatic car are not run properly and flat cars are not suitable for these roads. Because of very few height of car base to road that easily touch the road and fixed in the hole and damage the part of car. That's why in India only some expensive car are run on road and uses big size of vehicles are mostly use in India like bolero camper, Jip Truck ,Bus ,Taxi , Dustor car etc. Out of India mostly automatic cars are used and all type of vehicles are work on road. There is no holes and critical condition of road but in India road conditions are so unpredictable.

Image 5 : showing the Indian road condition in rainy season
Source: http://mastphotos.com/indian-roads-rainy-season-1615.html

As per the countryreports, inside and outside major cities, roads are often poorly maintained and congested. Even main roads frequently have only two lanes, with poor visibility and inadequate warning markers. On the few divided highways one can expect to meet local transportation traveling in the wrong direction, often without lights. Heavy traffic is the norm and includes (but is not limited to) overloaded trucks and buses, scooters, pedestrians, bullock and camel carts, horse or elephant riders en route to weddings, bicycles, and free-roaming livestock. Traffic in India moves on the left. If a driver hits a pedestrian or a cow, the vehicle and its occupants are at risk of being attacked by passersby. Such attacks pose significant risk of injury or death to the vehicle's occupants [6].

V.I. DRIVING AND ACCIDENTAL CONDITIONS IN INDIA

Because the road condition in India is not good therefore accidents are common problem on Indian Roads. According to figures by the Road Safety Cell of the Union Ministry of Road Transport and Highways, there were 3.9 lakh accidents in 2000; 78,911 were killed and 3, 99,265 injured. Moreover

with the rapid urbanization, India has seen an un-precedent growth of motor vehicles. Currently motor vehicle accidents rank ninth in order of disease burden and are projected to be ranked third in the year 2020. Worldwide, the number of people killed in road traffic crashes each year is estimated at almost 1.2 million, while the number injured could be as high as 50 million. In India, over 80,000 persons die in the traffic crashes annually, over 1.2 million are injured seriously and about 300000 disabled permanently [7].The study found that the majority of accidents occur either due to the driver's error or due to the negligence of the safety norms.

In the last 50 years, India's automobile population has grown 170 times while the road infrastructure has expanded only nine times. The country's vehicle population is over 5.5 crore and growing at a phenomenal rate of 25 lakh every year. Roads make up 4% of Kolkatta city as compared to 25% in Delhi and 30% in some other cities. Outside the metros, the main roads and other roads are poorly maintained and congested [8].

V.II. TRAFFIC JAMS IN INDIA

Traffic jam is one biggest problem due to road congestions, which tempt people to break traffic rules to escape the situation. This situation can be dangerous and often causing accidents. The other problem also occur like wastage of fuel, parking problem, air and noise pollution etc.

Image 6 : showing the Traffic jam condition in India
Source:https://theroadtochangeindia.wordpress.com/category/condit ion-of-india-roads/

V.II. In which condition Indian road helpful for automatic car?

For the self driven cars, there is a need to change the road condition in India. If the roads and highways becomes smarter with the help of technology upgradation then definitely the self driven cars will run on Indian roads in future.

When Indian roads are properly made by some sensors and show all instructions on board. Which is attached near by road. All those requirement are fulfil at each few distance repeated. Road must be clean without holes. Automatic cars are properly run on clean road. All these sensor require for give information about accident and crowd. The Automatic

cars are renewable source and we can say this automatic cars are obey renewable source.

The automobile industry is focusing to design the self drive car with the help of smart sensors: radars, LiDARs, and ultrasonic and vision based sensors etc. smart sensors having data gathering and self-diagnostics features for enhanced reliability, interoperability, and control. These sensors having the sensing capabilities that help to detect the obstacle, sense the wheather condition, communicate with other vehicles using V2V and V2I, and navigate safely without human intervention etc. These all the possibilities will be done when the road and highways will become smarter or we can say "smart highway/roads". "Smart Highway" is the concept to make highway roads smarter, safer, and more energy efficient for generating electricity using solar energy, vibration energy, wind energy, for charging the vehicles using these energies, for lighting, and for monitoring the condition of the road [9].

VI. SELF DRIVING VEHICLE COMMUNICATION

Self-driving vehicles in the coming years will hit on the roads. Therefore Roads and highways are soon to be the stage for a revolution. In order for this revolution to take place, the environment surrounding the vehicle must evolve as well. When in coming years, the million of future, Self-driving vehicles in will hit on the roads then there is great demand for fast communication between vehicle to vehicle and vehicle to infrastructure using wireless technology. In future every connected self driven vehicle requires wireless data transmission between V2V and V2I. These wireless communication for the self-driving cars, is a major deal in the future of road safety. For safety benefits , With the help of V2V and V2I communication, up to 80 percent of non-impaired crashes or accident could reduce or eliminate in near future.

Therefore in the coming years, for the safety benefits, all the self driven vehicles will communicate with each other wirelessly using V2V and V2I, and Wi-Fi technology will be embedded in infrastructure like traffic lights , street lights, stop signs, RFID reader etc. for two way communication between the self driven vehicles and infrastructure.

Every AV can be broadly classified into two categories: Vehicle-to-Vehicle (V2V) communication and Vehicle-to-Infrastructure (V2I) communication.

1. Vehicle-to-Vehicle (V2V) communication

It is an automobile technology which is designed to allow all the vehicles to talk or communicate to each other. V2V communication may develop further to form a wireless or vehicular ad hoc network (VANET) on the roads.

This technology will help to automobiles for sending messages to other vehicle with information about what they are doing including speed, location, direction of travel,

braking, and loss of stability. This technology will help to warn driver about potential accidents and prevent crashes. This technology uses dedicated short-range communications (DSRC). This system will use a frequency of 5.9GHz, which is used by WiFi. The range is up to 300 meters or 1000 feet or about 10 seconds at highway speeds. V2V would be a mesh network, meaning every node (car, smart traffic signal, etc.) could send, capture and retransmit signals [10].
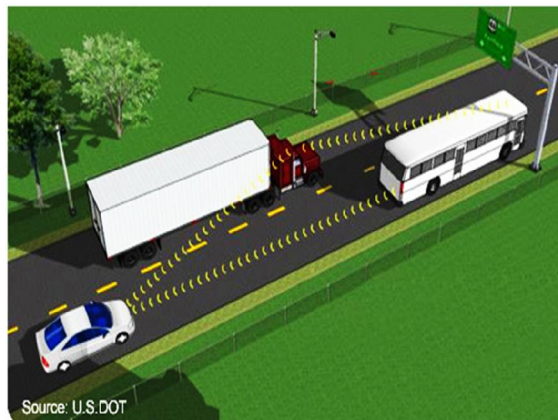

Image 7: showing the V2V communication between vehicles
Source:https://www.engineering.com/DesignerEdge/DesignerEdge Articles/ArticleID/13270/What-Tech-Will-it-Take-to-Put-Self-Driving-Cars-on-the-Road.aspx

1. Vehicle-to-Infrastructure (V2I) communication.

Vehicle-to-Infrastructure (V2I) communication is the wireless technology which is used to exchange of data between vehicles and road infrastructure. It is enabled by a system of hardware, software, and firmware. It is a bi-directional technology in which infrastructure components such as RFID readers, cameras, lane markings, road signs, and traffic lights ,street lights , signage and parking meters can wirelessly provide information to the vehicle and vice versa. V2I also uses short range communication (DSRC) frequencies to tranfer data (similar to V2V communication). In an intelligent transportation system (ITS), V2I sensors can capture infrastructure data and provide travelers with real-time advisories about such things as road conditions, traffic congestion, accidents, construction zones and parking availability. Likewise, traffic management supervision systems can use infrastructure and vehicle data to set variable speed limits and adjust traffic signal phase and timing (SPaT) to increase fuel economy and traffic flow. The hardware, software and firmware that makes communication between vehicles and roadway infrastructure is an important part of all driverless car initiatives [11].
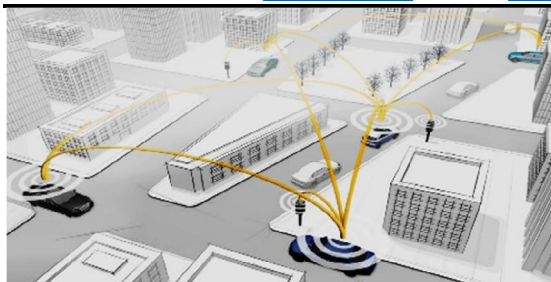
Image 8: showing the V2I communication
source:
https://www.engineering.com/DesignerEdge/DesignerEdgeArticles/
ArticleID/13270/What-Tech-Will-it-Take-to-Put-Self-Driving-
Cars-on-the-Road.aspx

VII. 5G COMMUNICATION: A FUTURE NEED FOR SELF DRIVEN VEHICLES

5G is the next generation wireless technology. It will support the M2M and IoT applications. 5G technology which help to deliver a safer, more convenient self-driving experience. This technology will help to million of self drive vehicles for better communication on roads. It provides more capacity, higher speed of data, ultra-low latency and it is also essential for vehicle-to-vehicle (V2V) and V2I (vehicle to infrastructure) connectivity in the era of self driven vehicles. In coming years million of self driven vehicles hit on the road but there will be a problem of big data and fast communication. Currently many manufacturers has already been trialled LTE network for V2V communication, such as exchanging information including hyper-local weather, road conditions, any obstacle and traffic data directly between vehicles. But current LTE network is incapable of handling this work. Therefore 5G is needed.

One of the biggest benefits of autonomous driving will be reducing road accidents. 5G will also make driving more accurate in terms of overtaking cyclists closely without risk of collision. Having autonomous cars driving closer together will also make better use of road capacity and cut carbon emissions [12].

VIII. CHALLENGES IN SELF DRIVEN CARS IN COMPARISION TO GOOGLE DRIVE AND MARUTI CELERIO

Many important challenges require for self driven vehicle like better hardware to collect more data, better software to make decisions based on that data, infrastructural changes as well, good roads with good markings, good weather condition etc.

Another challenge in Self-driving cars is able to navigate pedestrians and cyclists, manage drunk and distracted drivers, differentiate pot holes from puddles, handle detours and construction and drive through rain, sleet and snow.

IX. FUTURE SCOPE

The future of the self driven vehicle is very bright because it prevents the accident and serious injuries etc. In future Maruti celerio car is very useful of Indian people and comfortable. Its very helpful for environment, decreases pollution atleast 50% and helpful for those people who has do not know drive car. In Future self drive car run on Indian roads. This types of cars is the need of present time because of many accidents in India are done by cars. Therefore the self drive car is perfect solution of accident and that car have broad advantage for environment. But biggest problem in India is road conditions are not good. So its a need to change the road into some advancement like sensor based pathway, optical fiber based communication etc. In coming year many self driving electrical vehicles hit on the road. These electrical vehicle also charged by the renewable sources like wind, vibration etc. To charge these vehicles, need of some charging station on the road in future so that these cars will be automatically charged by the charging station and the payment will automatically done with the help of RFID based technology. In future ,fast communication is also required for self driven cars like 5G communication so that data or information will be transfer from one vehicle to another vehicle.

CONCLUSION

In this paper, we concluded that the self driving vehicles is the great demand in near future. It prevents many of the road accident and serious injuries. In India, currently the road conditions are not suitable for the self driving cars therefore in India, it's a first need of improving roads condition for self driving cars. For this purpose a first Indian team of six people that started the project Aerodrive as a startup for making the self driving cars. We concluded that the Google drive car named "Waymo" is the good car build with expensive equipments and technologies but for the Indian market its not suitable reason may be too expensive for individual customer and the present condition of Indian roads etc. some technological upgradations also required to improve the road condition in India. We also concluded that in future when million of self drive vehicles hit on the road then the demand of better and fast communication will be required between V2V and V2I. for these communication fastest internet speed will also be required for wireless communication . currently many automobile companies are working on LTE network but its incapable for fast communication in near future therefore 5G communication technology is required to solve these problems.

We also concluded that in the coming year many self driving electrical vehicles hit on the road to save the environment and free from the polution. These electrical vehicle also charged by the renewable sources like wind, vibration etc. To charge these vehicles, on the roadside the need of some charging station is required in future so that these cars will be automatically charged by the charging station and the payment will automatically done with the help of RFID based technology.

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