

Guidelines to convert Luxury Cars into Smart Cars

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1. Introduction :

The car is controlled by one of the intelligent system known as Adaptive Cruise Control (ACC). This is radar like system where laser setup keeps control the movements of the car. It maintains the system in front of back vehicles by speed up or slows down the car. If there is no vehicle in front of the car, it also increases the speed of the car. But this system can take decision only on straight roads and not on complicated route system. The car can't change the route based on GPS road system [1]. Now the need has arrived to find fully automated intelligent car to work in traffic system, to take decision without human interaction.

There are two issues to implement an intelligent system in cars. These are:

1.1 Technical Issues :

There are some technical issues like how the sensors can be designed to face the problems related to taking command as per the various maps. On the other hand, the sensor should be able to define the source and destinations based on current scenario [2].

1.2 Social Issues :

The trust of people on fully automated system is also a big challenge. The people enjoy driving the car. Driving a luxury car is pleasure. They feel secure when the complete control is there in their hands. There is a social issues that how the fully automated car can maintain both pleasure and security [3].

2. Objectives of the Study :

The main objectives of the study are:

- To study the present systems
- To identify the autonomous things required
- To study latest achievements for implementation

3. Present Systems in Luxury cars:

There are so many researches done by the researchers on some of the important issues. Some of them are very fruitful. Some of them are:

3.1 Laser Based ACC :

Laser based ACC is a low cost system available in entry level and medium level luxury cars. It is an effective system in normal environment. But the problem is it fails in complex weather especially in rainy season. Its sensors also fail to detect a non-reflective or dirty vehicle. In 2001, Toyota Lexus launched the next step of laser based ACC known as Dynamic Laser Cruise Control. This system has an advance feature to mitigate the collision through breaking system [4].

3.2 Radar Based ACC :

Radar based ACC is better system than laser based ACC. It is available in high level and premium level luxury cars. Mercedes-Benz and Jaguar Cars first adapted this system in 1999. It gives better performance in complex environment. The melody of this system is it intelligently increases the speed and manages the breaks of the car. But still this system has some limitations. It can't automatically choose the route and change the track. It manages the speed and the break on the basis of the distance with front car. In 2006, Audi Q7 and Mercedes-Benz launched the next step of Radar Based ACC known as Distronic Plus System. It takes the decision to halt the car immediately when it is necessary. This is the next level of safety in luxury cars [4].

3.3 Automated Highway System (AHS):

Out of that, one system is known as Automated Highway System (AHS) contains a special lanes with magnets which controls the car in the center of the infrastructure created by various images feed into the system. This system was first implemented by US government in highly secured vehicles in 1997. The system regularly calculates the distance with the nearby vehicles and avoids collision [5]. AHS also equipped with special features like 'Acceleration Lanes' to is to take the command of the car and 'Deceleration Lanes' to leave the command of the car. At the time of leaving command, AHS first assures that the driver is now ready to take control of the car. AHS also parks the car in parking safely.

3.4 High Occupancy Vehicles (HOV) :

This was also one of the US government project which had generated much press coverage in 1997 and appreciated as one of big achievement that time. The system is about to take control of the car by the inbuilt robot. The robots will work on special lanes on the road. This is very similar to train system. The vehicle needs driver support up to enter on special lanes. After that, the robots take control of the vehicle. It controls the speed, the direction, the start/stop actions

and everything which a driver can do. One more fruitful concept known as Swoop Technology, stores the history of the vehicle. The researcher can also store the previous recorded history in the vehicle. The robot can take help of stored history to take decisions.

4. Automation Required in Smart Cars :

The convert a luxury car into smart car require following features:

- 1.1 Sensors – To sense an environment
- 1.2 Navigation – The map
- 1.3 Motion Planning - To get directions
- 1.4 Actuation – To operate the staring

4.1 Sensors :

Basically sensors work on two approaches, namely Minimalist approach and Multi-Model approach. Minimalist works on human activities closely and Multi-Model approach searches the information to assist Minimalist approach to get the work done on the basis of the information feed in system and collected from the environment.

4.2 Navigation :

The navigation concept is first initiated by US military in a project known as Global Positioning System. Navigation is an ability to feed the maps of an environment in which the vehicle has to work. This is an ability of the vehicle to show its position on the map during its movements. The system takes the help of the satellite to get the current position online and also display the route target. It also recognizes the hurdles in the route through satellite and provides the updates to the system [6].

4.3 Motion Planning :

This is the technology to control the direction of the vehicle through mechanical means. It controls the function of the engine without the help of in built robotic system and receives just the instructions from the driver to give commands for movements. The commands are so matured that the driver just need to press the buttons of the desired effects of vehicles and the vehicle understand it.

4.4 Actuation :

This is the technology to control staring of a vehicle. In built robot senses the maps from navigation system and direction is handled by staring. This is a very important feature which is very near to human activities. The motion planning and actuation collectively keep control on vehicle with the help of sensors.

5. Proposed Concepts for Implementation:

This paper offer a complete and to end solutions for solving the problems of the current system.

These are:

5.1 Route Analysis :

Route Analysis is an intelligent system where the driver just needs to specify the destination. It takes help of GPS system to find present position of the car and forms the route to follow the destination. The melody of the system is it shows all alternatives of the route based on distance, time, cost, important spots and all other solutions. It provides the choices to the driver with the optimum solution. It driver don't select any of the choices, it automatically selects the optimum route and starts drive accordingly.

5.2 Autonomous Speed Adaption :

As we have discussed before, this feature is already available in Radar based ACC systems. But this system requires modifications. The present system manages the speed on the basis of front vehicle. The increasing or decreasing speeds are totally depends on the front vehicle's speed. Here, the driver also needs to specify the speed limits every time. The driver needs to take care of signals also. This means, though the present system is considered to be automatic, but most of the decisions are taken by drivers. The offered autonomous speed system need intelligent highway where the cars can communicate with the roads for red or green light system [7]. The highway should provide the data for risky locations like bridge, turning or under construction works. The car drives on this road, the car can automatically get the information of infrastructure of the road and it can control the speed accordingly. This can reduce the dependency of the driver on the car.

5.3 Curve and lane Detection :

Lane Detection is about detecting the curve movement on the road. GPS system doesn't give the clear information about the angle of the road on turning. Both Laser Based ACC and Radar Based ACC are unable to detect the location and the obstacles of the curve. There is of a system which can estimate the lane and the curve itself. This can be achieved by road side wireless signal system on the curve of the road to transmit the data about the distance of fences.

Lane changing in the traffic is another problem for the car. This can be done by making an arrangement of more radar on the car. If two radars placed on both sides of the car, that radars can check the distance of the vehicles of both sides. One more radar on the back side can check the back side vehicle as well as its movement to overtake. Based on the negative possibilities of driving car in same lane, the system can take the decision to change the lane.

5.4 Intelligent Breaking System :

The Radar Based ACC system provides the facility of the breaks. But it works just on the basis of the front vehicle. It can't detect obstacles on the road. This problem can be solved with the help of one video camera on front side to detect the obstacles and its size. The previous analysis can help the system to keep control on breaks and speed to manage the obstacle very similar to the judgments of the driver. Some additional features can also work according to the situation. It can tight the seatbelts of the passenger for safety, can generate alarm for other vehicles and can alert to driver for the critical situation.

5.5 Artificial Vision Image Processing :

Artificial Vision Image Processing is a technology which can sense an accident based on the movements of the other vehicles. The system can be considered fully fledged only when it can judge an accident on the basis of the movements of nearby vehicles. The implementation of this concept make the system very near to human behavior system which can immediately calculate the situation and forms the conclusion for taking instant action to survive. A video camera on front can take the images and create the database to support an artificial intelligent system.

5.6 Avoid Collusion :

Making an accident free car is always on priority. But due any critical situation, if accident happens, the collision on nearby vehicles is an immediate event happens in an accident. Avoiding collision on vehicles of nearby lane is a big challenge. It can reduce the impact of an accident. The long range lasers and short range ultrasonic sensors collectively identify the nearby vehicles. The roads with same kind of sensors can make it more prominent [8].

5.7 Assistance in Turning :

The biggest limitation of today's technology in luxury cars is they can work on straight roads only. The statistical reports prove that the car drives 90% distance in autonomous condition which requires very less level of intelligence. The rest of 10% distance tends to take the turning of the vehicles which requires the high level intelligence of the driver. The paper proposes the ultrasonic sensors on both car and roads can solve the problem.

5.8 Security Issues:

There are some security feature needs to be added. The owner or the user detection system of the luxury cars need to be more prominent. The finger print system on staring or one press button can recognize an authorize access of luxury cars. This will assure that the car won't be used by other person for an illegal means [9]. The airbag should be controlled fully by centralize system of the car. The airbag opening time should be variable based on the speed and the force of collision. Another important recommendation is, the luxury cars should get the access of the

central traffic system. This facility can wide the probabilities of the different routes and avoid the traffic jam.

6. Conclusion :

When we expect a system for the use, it should be fully fledged to satisfy the needs of the customers. The automation in luxury cars expects the completeness in all activities done by the driver. Luxury car is a section for very important persons where the implementation of high level security and automation is expected. The suggested modifications require at the most 5 years for achieving completely automated self dependent luxury car. The present cars are luxury, but not the smart one. The paper is an effort to explain everything need under the definition of smartness in luxury cars.

7. References :

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