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A LITERATURE REVIEW ON AUTO PILOT MODE TECHNOLOGY IN VEHICLES

Tanaji Bhosale
Student, Department of Mechanical Engineering,
Indira college of Engineering and management Pune, Savitribai Phule University Pune
tanajibhosale377@gmail.com

Prof. Sagar Chirade
Department of Mechanical Engineering,
Indira college of Engineering and management Pune, Savitribai Phule University Pune
chiradesagar@gmail.com

Abstract—the word “Auto pilot” mode means the process of implementing the advanced technology in vehicles which enables it to self-drive in roads without control of the driver. This system is to be achieved by the use of Radars, Sensors and Advanced GPS maps. First a compact path of the place where user wants to go is selected on the GPS map.

When the engine is started, all equipment’s will start to take positioning. The readings are obtained from the radar every second. It detects the objects at the limit of 180’ angle and continuously feed the control unit. This control unit is built with a lot of conditions that makes the vehicle to move in the possible safe directions. Here 50% of the job is done by the radar equipment’s and rest of the job is done by the advanced GPS mapping to make a safe journey. Separate signals are obtained from the ground level to detect the speed breakers and conditions of the road. Same set of equipment’s is fixed on the rear side of the vehicle to avoid other vehicles hit on rear side of the user’s vehicle.

I. INTRODUCTION

This Auto pilot mode technology is a research project. By implementing this technology in vehicles enables it to self-drive in the highway roads without the control of the humans. This technology creates a new revolution in the automobile and transport field. It helps the user to save their valuable time which is wasted while driving and it is not necessary for the drivers to be always seated in the driver seat except the places, where the signals and road counters present. Many accidents are occurred due to the carelessness of the drivers. This can be avoided by implementing this Autopilot mode technology. In this technology many advanced equipment’s are going to be used to make a safe journey. [1] This Autopilot mode technology is going to be created by the combination of various departments in Engineering. But among these departments of Engineering four departments are going to play a major role. [1]

They are Mechanical, Electronics, Information Technology and Computer science departments. Mechanical department is going to take care of all the mechanical movements of the vehicle. Electronics department take care of the fetching of programs made by the programmers in the controlling unit and for its proper functioning. Information technology and computer science departments are going to be the back bone of this technology. [2]

II. LITERATURE SURVEY

Autonomous Driving has been said to be the next big disruptive innovation in the years to come. Considered as being predominantly technology driven, it is supposed to have massive societal impact in all kinds of fields. In this section a brief overview on the technology and development will prove helpful to understand the need of customer acceptance.

All the benefits of course, and not only to mention the Technological difficulties do not come without a certain amount of challenges, complications and necessary changes in current systems in order to work. By now several States in the US have passed laws permitting autonomous cars testing on their roads (Walker S., 2014). The National Highway Traffic Safety Administration in the United States (2013) provides an official self-driving car classification dividing into No-Automation (Level 0), Function-specific Automation (Level 1), Combined Function Automation (Level 2), Limited Self-Driving Automation (Level 3) and Full Self-Driving Automation (Level 4). Europeans have also started modifying the Vienna Convention on Road Traffic and the Geneva Convention on Road Traffic (Reuters, 2014) in order to be able to adapt this new technology, but legal issues and doubt still arise as one of the main concerns of discussion. Some of the main issues surrounding the autonomous driving field found throughout the literature and the web are; test and standard set for critical event control, how to deal with the requirement for a ‘driver’, ownership and maintenance (Teare, 2014), civil and criminal liability, corporate manslaughter , insurance, data protection and privacy issues. Having a closer look at the history of Autonomous Driving, as explained in the IEEE Spectrum (Ross, 2014) in Figure 1 it can be observed that the technological development and main milestones of the autonomous driving field started already a few decades ago. Leading to a vast analysis of some semi-autonomous features, development of present technologies and understanding on the future problematic while focusing in the near future in the connected car.

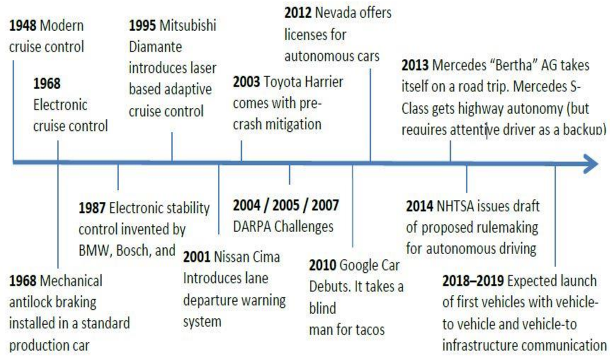


Fig no.01

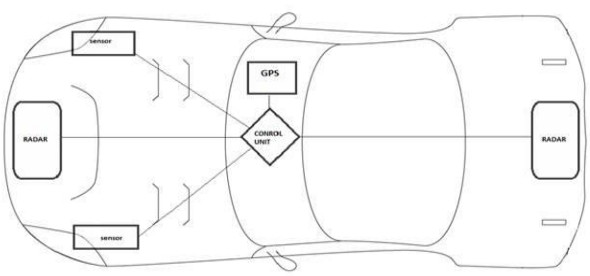
Autonomous cars are not that far away, for example Audi and Mercedes (Bartl, 2013) have announced almost being ready from production in highly automated features. As a reflection of the daily news, we can steadily see how this technology manages to get closer to be in our everyday life, with examples of cars driving a blind man for tacos already on 2012 (Google, 2012), coast to coast trips (CNN, 2015), an Italy to China trip (Broggi, et al., 2013) and 700,000 miles already travelled by Google (Urmson, 2014). But main automakers in the race such as Audi, BMW, Cadillac, Ford, General Motors, Jaguar, Land Rover, Lincon, Mercedes-Benz, Nissan, Tesla and Volvo, are trying to integrate it slowly to their models despite the fairly readiness of the technology. This can be interpreted as a futile attempt to keep this totally disruptive technology under control and to have overall slower customer integration, but this old model will prove to be not good enough due to the magnitude and impact of this technology (Bartl, 2015).

The research conducted focused in a systematic keyword search in the topic section of literature databases, including EBSCO, Science Direct, Emerald and ISI web of knowledge. The search conducted included the specific terms, “Autonomous driving”, “Self driving car” and “Driverless car” either in the title, keywords or abstract and including only academic journals listed in the mentioned databases. Hence, the aim of this research was not to find all literature regarding Autonomous Driving that because of its size would lead to an enormous amount of results due to the extensive applications, testing and research in other fields (robotics, underwater vehicles, military, aeronautics, space vehicles, etc.), but to achieve an overview and overall classification to identify current gaps in the scientific literature body. Therefore taking into consideration only the literature publications relevant for roads, traffic, crossroads and studies related to commuting, transportation or production, and including all relevant publications found related to the automotive industry, as well as also considering papers in other topics that acknowledge that the application could be relevant for self-driving cars. [2]

III. ACTUAL WORKING

They are Mechanical, Electronics, Information Technology and Computer science departments. Mechanical department is going to take care of all the mechanical movements of the vehicle. Electronics department take care of the fetching of programs made by the programmers in the controlling unit and for its proper functioning. Information technology and computer science departments are going to be the back bone of this technology. [3][4]

This technology depends up on the components which are represented above. First the compact map path to the place where the user wants to go is selected on the GPS maps in the display unit. When the user starts the engine all the equipment’s will take positioning. The readings are obtained from the radar every second. It detects the objects at the limit of 180’ angle and continuously feed the control unit there by moving the vehicle in safe and proper directions. Control unit is built with a lot of conditions that makes the vehicle to move in the possible safe directions according to the readings from the radar, sensor and GPS maps. [3][4][5]



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ig No.02 [8]

Here 50% of the job is done by the radar equipment’s and rest of the job is done by the advanced GPS mapping to make a safe journey. Separate signals are obtained from the sensors which are kept at the bottom of the car straight to the wheel to detect the speed breakers and road damages which help the vehicle to de-accelerate in the speed breaker and damaged road areas. Advanced GPS mapping technology makes the car to remain in the Indian rule of “keep left”. It synchronizes the vehicle and the road. This only helps the vehicle to turn properly during the curves. Same set of the equipment’s is fixed on the rear side of the vehicle to avoid other vehicles to hit the user’s vehicle during de-acceleration, curves and overtaking. [3][4][5][6][7]

IV. COMPONENTS

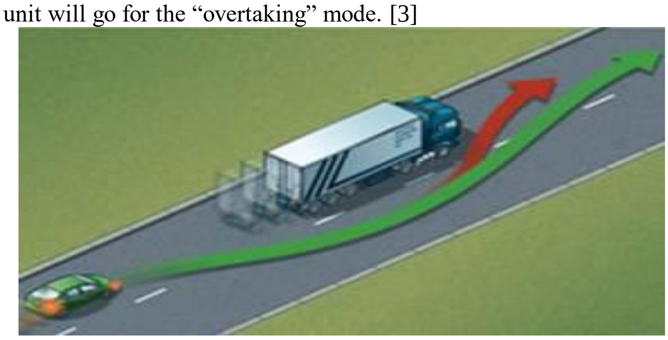
RADAR
SENSORS
ADVANCED GPS MAPPING SYSTEMS
DISPLAY UNIT

RADAR

Radar is an object detection system that uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain. The term RADAR is defined as radio detection and ranging. A radar system has a transmitter that emits radio waves. When they come into contact with an object they are scattered in all directions. The signal is thus partly reflected back and it has a slight change of wavelength (and thus frequency) if the target is moving. The optimal range can be fixed as 50m.The receiver is usually, in the same location as the transmitter. Although the signal returned is usually very weak, the signal can be amplified through use of electronic techniques in the receiver and in the antenna configuration. This enables radar to detect objects at ranges where other emissions from the target object, such as sound or visible light, would be too weak to detect. [3]

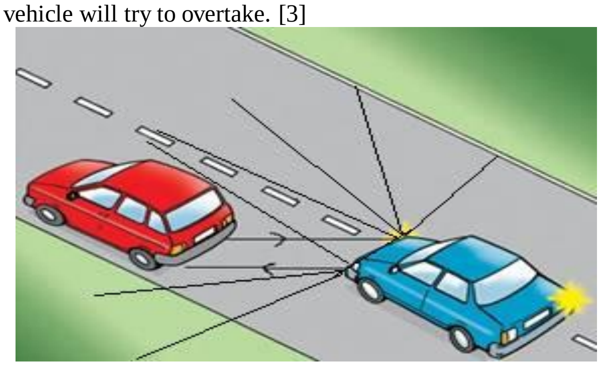
Pic No.01 [8]

From the above fig no.02 it has been observed that the radar signals are transmitted and readings of the detected object is received by the reflected signals from it in front of the car. By the radar readings the control unit automatically accelerates and de-accelerates the car. In case object in front of the car moving slowly means then the control unit will go for the “overtaking” mode. [3]



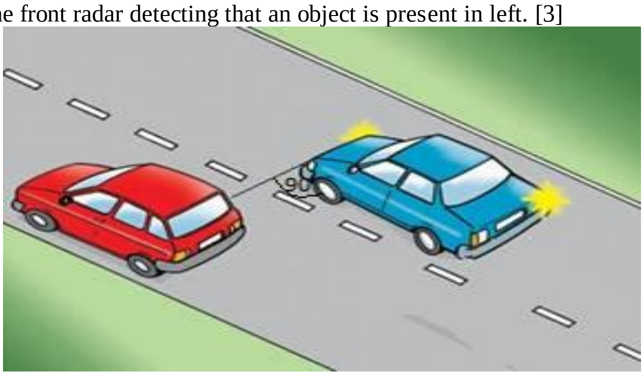
Pic No.02 [8]

Before overtaking it is necessary to analyses what might go wrong while overtaking. This mode will find the possible direction and space to overtake the object in the front to move ahead. How this process works means; at first the signal from the front radar is obtained that, object is present in the front of the car. Now the radar will analyze whether it is possible to overtake. If it is possible means the vehicle will try to overtake. [3]



Pic No.03 [8]

There is a possibility for the vehicle to hit the object while steering left during overtakes. A constant signal of 90 degree is obtained from the front radar detecting that an object is present in left. [3]



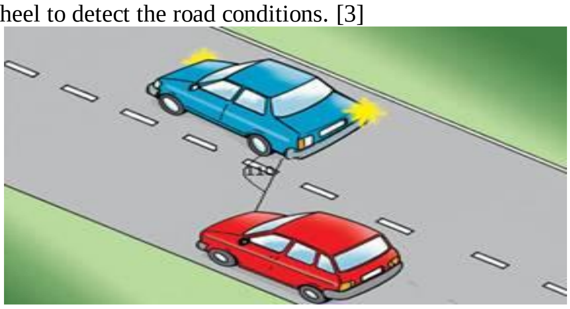
Pic No.04 [8]

After the front radar crossed the vehicle, readings will start to come from the rear radar. This will indicate that the object is still present and now cannot steer left. A constant reading will be taken from the rear radar as 90 degree. This will not change until the rear radar crosses the object [3]

When the back radar crossed the object the angle 90 degree will start to increase. This detects that the car had crossed the object. A particular degree is denoted in the program, when the vehicle has to steer. 110 degree is enough to steer the vehicle safely. [3]

Pic No.05 [8]

Thus the overtake mode is achieved successfully. This is how the process is going to work. Radars cannot detect the road condition as it is kept at the bumper of the car. So, separate sensors are kept near the wheel to detect the road conditions. [3]



Pic No.06 [8]

SENSOR

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Here sensors are kept near the front wheel there by focusing the road as shown at an angle of 160 degree. The terms "sensor" and "transducer" have often been used as synonyms. The American National Standards Institute (ANSI) standard defines a transducer as "a device which provides a usable output in response to a specific measurand". An output is defined as an "electrical quantity," and a measurand is "a physical quantity, property, or condition which is measured." the ANSI standard stated that "transducer" was preferred to "sensor." However, the scientific literature has not generally adopted the ANSI definitions, and thus currently "sensor" is the most commonly used term. [4]

In order to describe and characterize the performance of a sensor, a large and specific vocabulary is required. Several excellent references, which provide a basic review of transducer characteristics.

Sensor Characteristics [4]

Table-01

Static	Dynamic	Accuracy
Dynamic error response	Distortion	Hysteresis
Instability and drift	Minimum detectable signal	Noise
Nonlinearity	Operating range	Selectivity/specific
Repeatability	Sensitivity	Step response
Threshold		

Classifying the signal domains in the manner while not precise, demonstrates that understanding the physics of the application is vital to selecting the appropriate sensor scheme, materials, and design. It is one method of visualizing the transduction principles involved in sensing.

Sensor Energy Forms [4][5]

Table-02

Energy Form	Example Measurand
Mechanical	Length, Area, Volume, all time derivation such as linear/angular acceleration, mass flow, force, torque, pressure.
Thermal	Temperature, Specific heat, entropy, heat flow.
Electrical	Voltage, Current, charge, resistance, inductance, capacitance, dielectric constant, polarization, electric field, frequency, dipole moment.
Radiant	Intensity, Phase, Wavelength, polarization, reflectance, transmittance, reflective index.
Magnetic	Field intensity, Flux density, magnetic moment, permeability.

The sensor will always focus the road like a stick from the car. A constant reading will be provided from the sensor to the control unit. When the angle changes due to any speed breaker or road damage, the sensor will automatically makes the control unit to slow down the car. If the value crosses the critical value the car will be stopped immediately because, there may be any huge damage. [4][5]

ADVANCED GPS MAPPING SYSTEM

Global Positioning System, a system that's changed navigation forever. The Global Positioning System (GPS) is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations.
GPS uses these "man-made stars" as reference points to calculate positions accurate to a matter of meters. In fact, with advanced forms of GPS you can make measurements to better than a centimeter. [6]

GPS works in five logical steps-

1. The basis of GPS is "triangulation" from satellites.
2. To "triangulate," a GPS receiver measures distance using the travel time of radio signals.
3. To measure travel time, GPS needs very accurate timing which it achieves with some tricks.
4. Along with distance, you need to know exactly where the satellites are in space. High orbits and careful monitoring are the secret.
5. Finally you must correct for any delays the signal experiences as it travels through the atmosphere.

GPS signal in detail

Carriers
The GPS satellites transmit signals on two carrier frequencies. The L1 carrier is 1575.42 MHz and carries both the status message and a pseudo-random code for timing.
The L2 carrier is 1227.60 MHz and is used for the more precise military pseudo-random code [6]

Pseudo-Random Codes

There are two types of pseudo-random code (see tutorial for explanation of pseudo random codes in general). The first pseudo-random code is called the C/A (Coarse Acquisition) code. It modulates the L1 carrier. It repeats every 1023 bits and modulates at a 1MHz rate. Each satellite has a unique pseudo-random code. The C/A code is the basis for civilian GPS use.
The second pseudo-random code is called the P (Precise) code. It repeats on a seven day cycle and modulates both the L1 and L2 carriers at a 10MHz rate. This code is intended for military users and can be encrypted. When it's encrypted it's called "Y" code. Since P code is more complicated than C/A it's more difficult for receivers to acquire. That's why many military receivers start by acquiring the C/A code first and then move on to P code. [6]

Navigation Message-

There is a low frequency signal added to the L1 codes that gives information about the satellite's orbits, their clock corrections and other system status.
There are several good reasons for that complexity: First, the complex pattern helps make sure that the receiver doesn't accidentally sync up to some other signal. The patterns are so complex that it's highly unlikely that a stray signal will have exactly the same shape. Since each satellite has its own unique Pseudo-Random Code this complexity also guarantees that the receiver won't accidentally pick up another satellite's signal. So all the satellites can use the same frequency without jamming each other. And it makes it more difficult for a hostile force to jam the system. In fact the Pseudo Random Code gives them a way to control access to the system. [6]

Using GPS for Timing -

We generally think of GPS as a navigation or positioning resource but the fact that every GPS receiver is synchronized to universal time makes it the most widely available source of precise time. This opens up a wide range of applications beyond positioning. GPS is being used to synchronize computer networks, calibrate other navigation systems, and synchronize motion picture equipment and much more. The secret to perfect timing is to make an extra satellite measurement. That's right, if three perfect measurements can locate a point in 3-dimensional space, then four imperfect measurements can do the same thing.
The problem-
Remember that GPS receivers use timing signals from at least four satellites to establish a position. Each of those timing signals is going to have some error or delay depending on what sort of perils have befallen it on its trip down to us. Since each of the timing signals that go into a position calculation has some error, that calculation is going to be a compounding of those errors. [6]
DISPLAY UNIT

Functions of Display Systems

(1) A display system shall not present the kind of information that impairs the safety and Smooth flow of road traffic.
(2) It is desirable that a display system be designed, where possible, to comply with an Internationally agreed standard respecting readability, audibility, icons, symbols, Letters, abbreviations, and other factors relating to the manner of information display.
(3) The luminous intensity, contrast, colors and other display conditions of a display
System shall be important. [7]

Presentation of Auditory Information

(1) A display system shall be equipped with a means of controlling auditory information, but not including alarms, for the checking time who may find auditory information distracting.
(2) A display system shall not be capable of generating an uncontrollable volume of Sound that may cancel out alarms sounded from inside or outside of the vehicle. [7]

Display System Operation While Vehicle in Motion

Importantly, while operating the display systems of their vehicles, display systems in response to displayed information must be confined within the time allowance given by confronting traffic situations. Furthermore, display system is slow, even though the surrounding situation demands full attention to driving.
For these reasons, the following requirements should be fulfilled with a view to enabling
(1) The operation of a display system shall not result in a marked obstruction of forward field visibility.
(2) Preferably, the visual information to be displayed is sufficiently small in volume or is presented in portions so that the display system can be operated in separate steps.
(3) Preferably, a display system is so designed that its display of information can be discontinued by the system.
(4) Preferably, when its display of information is discontinued, a display system is capable of resuming the display from the point of\ discontinuation or a point enabling the understanding of the displayed information as a whole.
(5) Information, such as the reporting of system state and operation that is displayed in response to the data inputted by the system shall be quickly and easily comprehensible.

Map display function

(1) Maps to be displayed for navigation purposes shall not show minor roads in urban areas However, if the indication of such roads causes the system neither to gaze continuously at nor to look for shortcut routes on the screen, minor roads in urban areas may be shown in navigation maps on the following conditions:
a. Those minor roads deemed important in the entire network of roads may be shown.
b. In maps more detailed than a 1:20,000 scale, minor roads may be shown only while running on narrow roads. However, when the map on the screen is manually scrolled (including improved and simplified scrolling operations), minor roads shall not be shown.

c. In maps of a 1:5,000 or more detailed scale, minor roads may be shown while the vehicle is in motion. However, when the map on the screen is manually scrolled (including improved and simplified scrolling operations), minor roads shall not be shown. [7]

V. CONCLISION

By implementing this Autopilot mode technology will surely reduce the occurrences of road accidents by a considerable value. In the future, the wide acceptance of my technology will create an "Accident free world"

ACKNOWLEDGMENT

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