AUTONOMOUS CARS

(EMBEDDED SYSTEMS)

Abstract:

As you go about the affair of living, you put your life safe and luxurious with all the available resources .Now a days we all are entrenched with computers and almost all depended on them. Devices with intelligence rule the world. Imbibing intelligence to these devices is through a system called **"EMBEDDED SYSTEM"**. Its applications provide marvelous opportunities for ingenious use of computer technology. Almost all every system introduced into the market is an example of Embedded System. An embedded device finds applications in all segments of industrial and commercial marketplace. Home appliances, mobile phones, Personal Digital Assistants (PDA), cars, tiny microchips and avionics are all using embedded technology.

The current topic "AUTONOMOUS CARS" that we are going to present is one of the fine examples of Embedded System.

Is autonomous car a myth or reality?

There are many paradigm shifts taking place due to information explosion and the concept of autonomous vehicle is one shift. The car, which is embedded, can simulate the human driver completely and direct the vehicle on the road. Autonomous vehicle has been the dream of scientists for long. Now their dream has come true as with drastic changes in technical brilliance and developments in different fields with **EMBEDDED SYSTEM** as pioneer.

Introduction:

The term embedded system is quite a complex one. Simply it is a combination of hardware and software that forms the component of a larger system, this in turn is programmed to perform a range of dedicated functions usually with a minimal operator intervention. In embedded systems the hardware is normally unique to a given application, computer chips are embedded into the control electronics to manage the products functionality.

Embedded systems are rapidly becoming a catalyst for change in computing data communications, telecommunications, industrial control and entertainment sectors. New innovative applications in these as well as other areas such as home networking and car infotainment will roll out in the near feature.

The fine art of automation:

Just imagine. We load the code of our destination in the dashboard computer and turn the car on, while we remain seated carefree on the rear seats. Then its all the job of the 'unknown' to drive it on the roads, bridges, thought the bazaars, past the crossings to the destination, without getting challenged even once for traffic rule violations.

A fully computerized car capable of doing almost every thing a car lover would want to. Seems like fantasy but a day is not far when almost all automobiles will interact with computer on dashboards. From ordering pizza to booking tickets at the nearest theatre, things would be as easy as giving orders to your servant. As a matter of fact, vehicles all over the world are now fitted with intelligent devices that make the vehicles to respond to various factors –be it climate control, sudden accelerations or braking or even self-repair of modules.

There are trends where the finger print technologies are also have been introduced which gives the following reliabilities .You could one day be able to enter and start your car with the touch of a finger. And that same touch, with your fingerprint acting as a key, would trigger a check of the mirrors, steering wheel, radio and temperature to ensure that they're the way you like them. The convenience of fingerprint recognition technology comes with heightened security. Unlike personal identification numbers, passwords and keys, each person's unique fingerprints can't be duplicated, lost or forgotten.

Description:

As stated above that a vehicle can run by itself with out the intervention of human beings by the embedded intelligence in it. For this purpose Global Positioning System (G.P.S) using satellites can provide positioning information and proves to be a versatile all-time. For still higher accuracy wide area differential GPS is used, which offers a robust system that readily deals with selective availability errors and satellite clock errors.

An error level of decimeter/centimeter is guaranteed by WADGPS. Which satisfies the ground vehicle control algorithm. Human intervention is completely eliminated by using of reliable sensors and actuators. Making the overall performance of transporting system both congestion-free and collision incorporate the concept of WADGPS they're –free, besides making it cost effective.

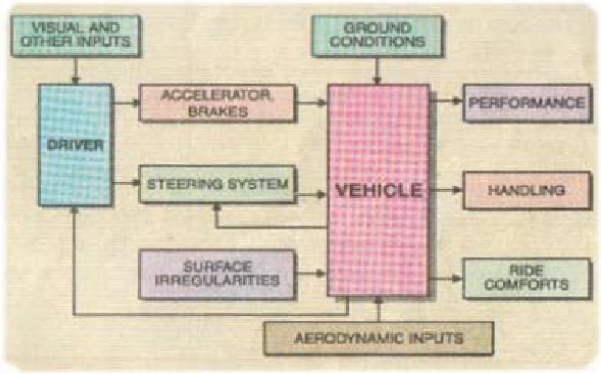
The models for GPS also include aiding sensors, e.g. dead reckoning, radar and camera. A computer is simply required to feed destination into a dashboard computer. Highly sensitive actuators simulate a human driver completely and direct the vehicle on the road. The vehicle transmitter broadcasts its position and velocity to other immediate participants for collision-avoidance and lane changing manoeuvres. Forward and reverse motions and u-turns are precisely achieved as per route guidance requirements. Furthermore, an accurate steering control is obtained using Pulse Code Modulation technique and acceleration/braking control is successfully implemented using learning adaptive system.

The simplest form of vehicle navigation employs a heading sensor, velocity sensor and a processor. Typically a navigation system requires an input of initial position and it self-initializes the heading sensor with respect to north. The processor then integrates the velocity sensor output to determine distance traveled and resolves the heading sensor data to calculate a new position. This reckoning navigation requires additional vision sensors, route guidance and map-matching algorithms for making the driving tasks fully automatic.

The remarkable advances in microelectronics and data processing technology have made possible the miniaturization of sensors the integration and combination of data from a number of sensors. Television cameras, charge coupled device (CCD) type sensors, laser radar and infrared sensors may be used.

The reliability, efficiency and cost effectiveness of an autonomous vehicle depend mainly on how judiciously its navigation sensors, perception unit and computer control is incorporated and how well their performance meets today's transportation needs. Quite of ten a human driver is forced to maintain attention for long periods of time and commit to unpredictable contingencies on the free ways together with traffic jams. All this leads to fatigue and hypovigiliance at the wheel and consequently to more frequent collisions and congestion.

The drivers activity is influenced by several factors that depend on driver itself and is environment such as traffic density, traffic status, time of travel and weather. Thus the driving activity deals with a combined driver vehicle-environment system shown in figure

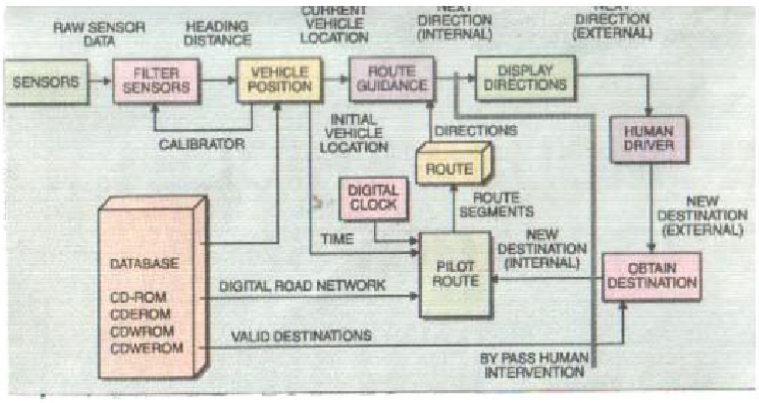


The vehicle is required to blend its environmental perception capabilities with its intelligent controls in order to effect optimal path-planning strategies that not only avoid obstacles but also minimize criteria such as time of travel, fuel consumption, exposure to pollution/danger, etc. however basic driving functions consists of lane-keeping, safe distance maintenance, timely lane changing and overtaking. The key to all these driving tasks is collision avoidance.

The Master Control Station (MCS) receives the positioning information from the satellite by employing WADGPS concept. The MCS is linked to GPS instrumented position location systems (PLS) installed on the autonomous vehicles through a data link sub system (DLS). The DLS can either use VHF or UHF or L-band, incorporating time division multiple access protocol to handle on the roads. A block forward error correction code is employed to protect and maintain the message integrity.

The vehicle route guidance systems gave maturity to the point of practical usefulness as well as cost effectiveness. Such a system is responsible for selecting optimal routes in a given road network and for providing digitized directions to a human driver and or an autonomous system, emphasizing the path of least resistance with consumption of minimum fuel or minimum exposure to pollution /danger criteria

Figure below shows a series of interconnected functional subsystems of hardware by software components



The desired

destination and starting position of the vehicle together with the time of travel, manifest an optimal route on the road network. Once the vehicle commences the journey, the sensors continuously keep track of the direction and displacement of the vehicle initial calibration is a little crucial for dead reckoning performance; how ever a feed back calibration indicated in fig 2 suggested to obtain distance accuracy better than 99.9 percent.

The new generation microprocessors promises further increase in system capabilities while simultaneously shrinking both volume and power consumption of the autonomous vehicle embedded system. The digital road maps, available on CD-ROM's have substantially increased safety of automobiles. These maps along with GPS navigation provide a feasible solution to autonomous vehicle system. The expert system technologies are integrated with digital maps along with the CCD camera images, magnetic compass, and the GPS system, for obtaining a real time intelligent decision support navigation package. The integration of GPS and communication suggests an efficient transportation system for increasing the road traffic safety smooth driving without traffic jams and a comfortable driving environment. Further more the autonomous vehicle relies on such intelligent system integration that leads to complete collision free in time of real time situation.

The vehicle transmitting system continuously provides information about its position and velocity to its participants. A safe distance with respect to its immediate surroundings is maintained by acceleration/brakes and steering controls. The internal platform and rate gyro and accelerometer package keeps the vehicles central processing unit (CPU) well informed about the incremental changes in the vehicles parameters. The wheel odometers provide the vehicle traveling distances by multiplying the number of electronically generated pulses by a constant, depending upon wheels perimeter

As the actual tyre size is influenced by vehicles speed, tyre pressure play load and atmospheric conditions, appropriate corrections are maid by the CPU. The atmospheric data system keeps continuous record of outside atmospheric temperature, pressure and differential pressure.

The information concerning deviation from the road center is obtained by magnetic as well as optical sensors, and fed to the CPU. The GPS receiver updates the vehicles position and velocity to centimeter/decimeter levels as required for the lateral or longitudinal control actions. The autonomous vehicle embedded software mission finally yields the estimates for throttle and heading angle increments for a safe and accident free Manoeuvre. The following figure gives an indication of all the technologies used in a car

. Hybrid automobile is envisaged at the juncture, which has heat engine propulsion (options for switching over to electric devices with intelligent brakes and acceleration) And computer for optimal route selection, map matching and collision-avoidance. The reduced cost of GPS augmented vehicles using the off-the-shelf equipment would lead to an intelligent transportation system with substantial share of electronically controlled next generation vehicles. It is hoped that hybrid electric vehicles shall be readily accepted by our information-based society.

Advantages and comforts:

- The adoptive cruise control ACC technology used in the cars from automobile makers keeps advancing to new levels of safety. In microwave radar unit there is a laser transceiver, fixed on the front of the car to determine the distance and relative speed of any vehicle in its path, which keeps safe distances from other vehicles on the busy roads. The driver can set the speed of his car and the distance between his and other cars. When traffic slows down vehicle speed is altered using moderate braking to maintain a constant distance between his and other cars.

- In advanced systems just in the case the driver over speeds or suddenly falls over and guides the car to a safe halt. And if you have programmed it right, the GPS in the car would take you to your destination .so, right from brakes to automatic traction control to air bags and fuel-air mixture control, the intelligence takes over.
- A few advanced car prototypes with embedded systems have been tried and tested where even if a smart thief has managed to break in through the car, the car doesn't start up even if it does the computer I the car would lock the steering wheel and cutoff the fuel injection supply … in the mean time a signal is set to the nearest police station and the owner informing them about the thief.
- Some designs now include so-called "pre-safe" systems, which sense possible collisions in advance based on emergency braking, skidding, and sudden evasive maneuvers. They will prepare a car by automatically moving the front seat either backward or forward for the safest distance from the instrument panel, adjusting the seat belt for the correct tension, and even closing the sunroof in case of a potential rollover. The idea is to "cradle" the car's occupants for maximum safety.

Indian efforts in embedded system development:

Our India too entered into the field of embedded systems and had great developments in this field. It got marvelous results in the field of "Telematics" which is a part of technology used in cars. The description about it was discussed

Total telematics experience is what they are looking for simply put telematics is the vehicles capability to communicate with the outside world and or the vehicle operator. It is a combination of telecommunication and computing.

Imagine when you are busy negotiating through rush hour traffic, you get a call on your mobile. You know the call is from your office but can't attend to it.

"How nice it would have been if somebody would answer your phone call and at the same time guide you systematically through the traffic?"

Mistral software, which was developed in India, has text-to-speech and speech recognition technologies to give the car occupants the ultimate comfort. So whenever there is a call on your mobile. You need not get jump at the very onset of the call. Relax the computer in the cars dashboard would do the job for you.

GPS navigation guides you through the traffic. The GPS interface in the car pinpoints your exact location on a map. In case the GPS signal can't be received due to high density of tall buildings or other magnetic interface, the 'dead reckoning ' technique, which works for short durations guides you effectively. The system is also loaded with GSM/CDMA protocol standards further modified on the CANBUS standard give uninterrupted information.

Another device called the array microphone cuts off the surrounding noise and allows the speaker to communicate effectively. The person at the other end hears the voice of the speaker without any out side interference.

Conclusion:

With the heights of the technology autonomous car is no more a myth. It's a reality!

We would like to present that there must be further developments in this technology to make autonomous car more common all over the world. This can be happened

by making the autonomous easy to operate for the user and the designers should concentrate more in producing autonomous cars, which should not cost a lot, they should in the vicinity of customer's budget. With this type of vehicles there will be great advantages in the coming feature. Due to speed control technique, accident free driving is possible and fuel savage is also made possible by the technique, which will make the car to travel through shortest path. In the near future, autonomous car become more common all over the world. Indian efforts in the embedded technology can assure that these autonomous cars will become cheaper and may evolve with many more advantages. So that we could find ourselves using these autonomous cars in the near feature.

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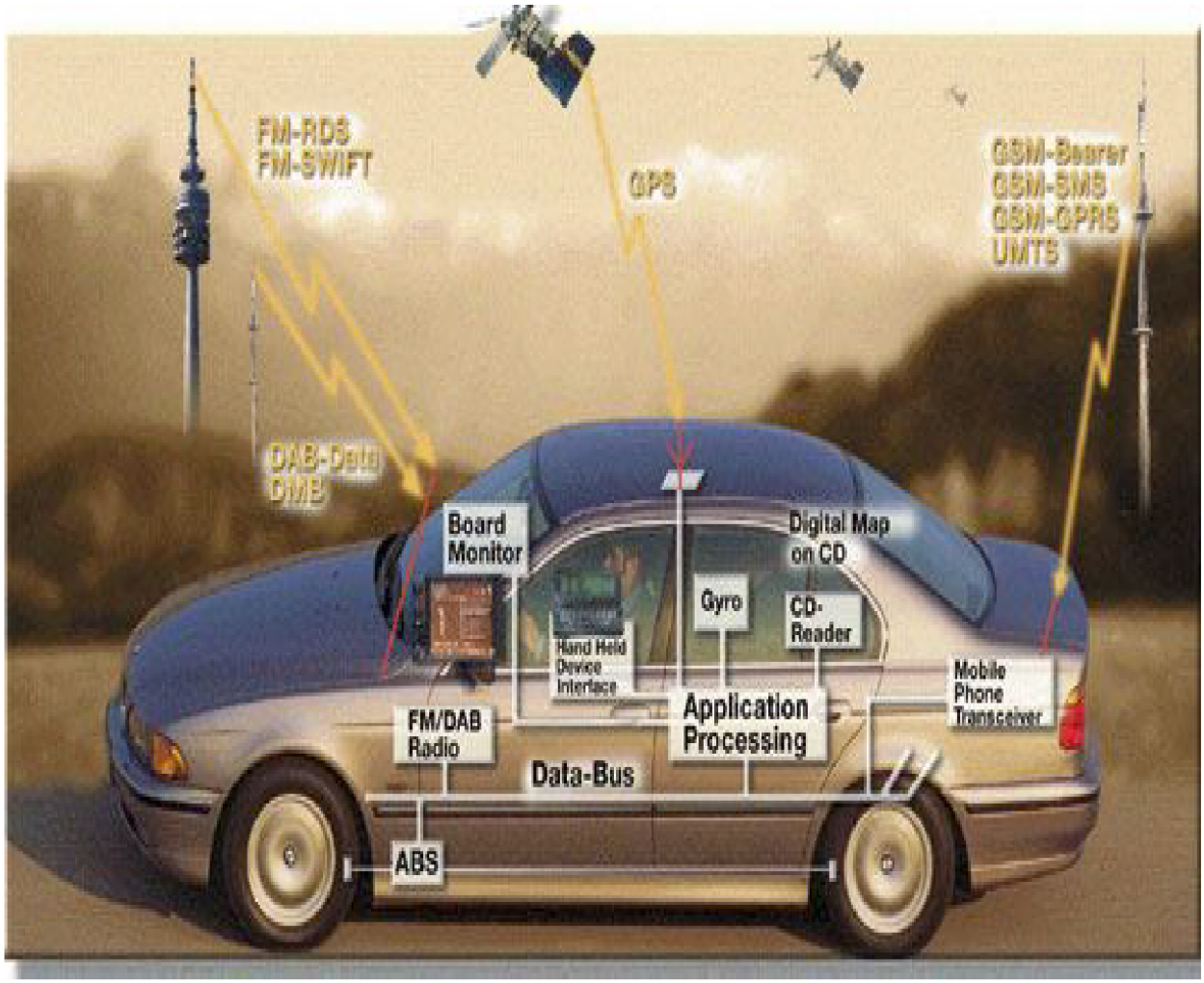

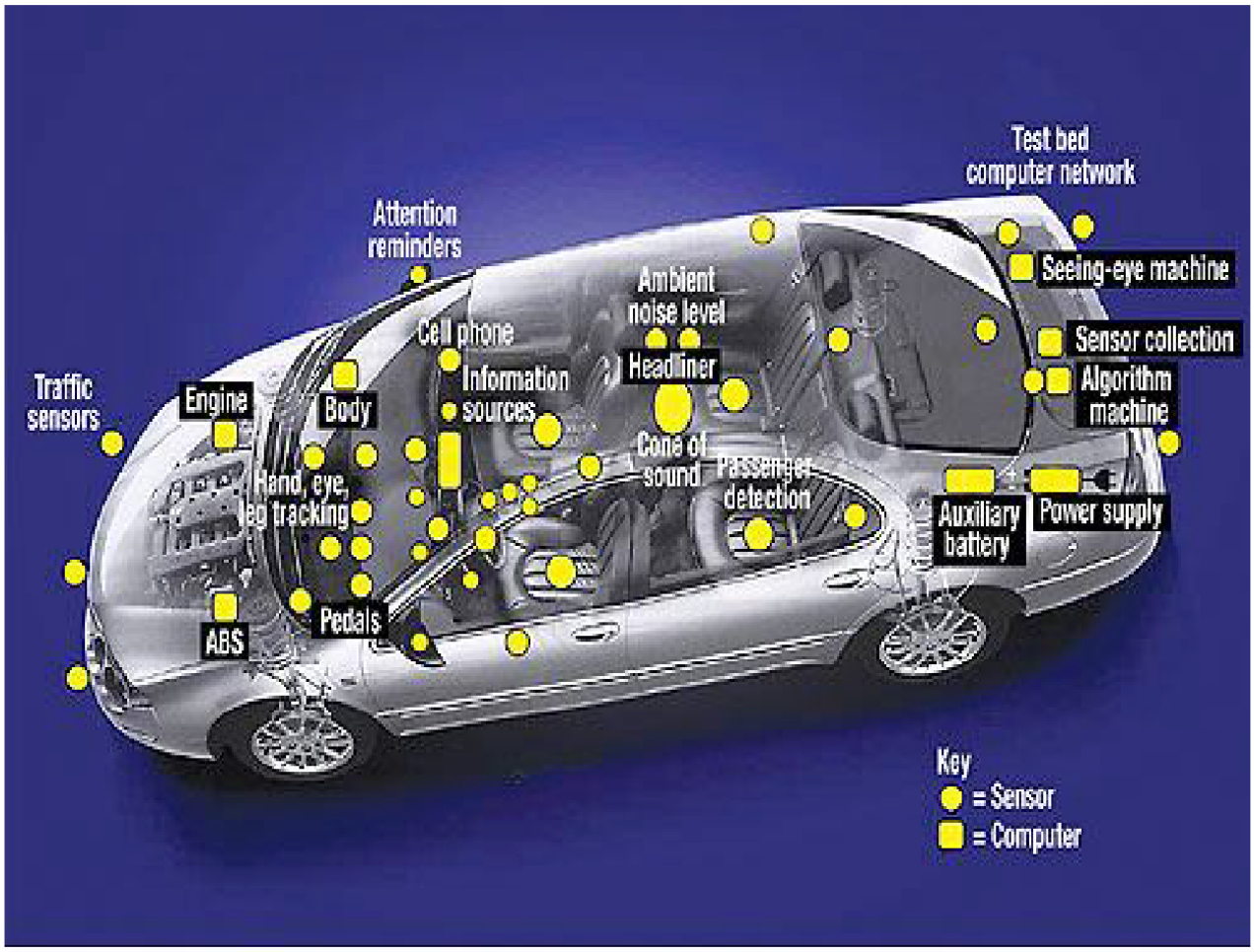

1. Daimler-Chrysler's 300M IT concept vehicle embodies the fully instrumented car of the future. It uses a variety of sensors to help drivers concentrate on the road for safer driving.