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Modern Techniques to Attain Smart Vehicular Schemes using Embedded Systems

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Abstract

The technical challenges that remain to be mastered to be involve software safety, fault detection, a malfunction management. The state of the art of software design not yet sufficiently advanced to support the development of software that can be guaranteed to perform correctly in safety–critical application has complex road vehicle automation excellent performance of automated vehicle control system has been proven under normal operating conditions, in the absence of failures. Elementary fault detection and mall function management systems have already being implemented to address the most frequently encounter fault conditions, for use by well-trained test drivers. However, commercially implemented will need to address all realistic scenarios and provide safe responses even when the driver is a completely untrained member of the general public. Significant efforts are still needed to develop system hardware and software designs that can satisfy these requirements. The non-technical challenges involve issues of liability, costs, and perception. Automated control of vehicles shifts liability for most crashes from the individual driver (and his or her insurance company) to the designer, developer and vendor of the vehicle and roadway control systems. Provided the system is indeed safer than today's driver-vehicle highway system, overall liability exposure should be reduced. But its costs will be shifted from automobile insurance premiums to the purchase or lease price of the automated vehicle and toll for use of the automated highway facility. All new technologies tend to be costly when they become available in small quantities, then their costs decline as production volumes increase and the technologies nature. We should expect vehicle automation technologies to follow the same patter. They may initially be economically viable only for heavy vehicles (transit buses, commercial trucks) and high-end passenger cars. However, it should not take long for the costs to become affordable to a wide range of vehicle owners and operators, especially with many of the enabling technologies already being commercialized for volume production today .It is important to recognize that automated vehicles are already carrying millions of passengers every day. Most major airports have automated people movers that transfer passengers among terminal buildings. Urban transit lines in Paris, London, Vancouver, Lyon and Lillie, among others, are operating with completely automated, driverless vehicles; some have been doing so for more than a decade. Modern commercial aircraft operate on autopilot for much of the time, and they also land under automatic control at suitably equipped airports on a regular basis. The main goal of this paper is to make the experience of driving less burdensome and accident less, especially on long trips. This can be achieved by making the highway itself part of the driving experience and integrating roadside technologies that would allow the overburdened highway system to be used more efficiently.

Keywords

Overburdened Highway System, Automatic Throttle, Braking Control, Steering Control.

I. Introduction

Intelligent transport systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitor applications, such as security CCTV systems; and to more advanced applications that integrate live

data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge de-icing (US deicing) systems; and the like. Additionally, predictive techniques are being developed to allow advanced modelling and comparison with historical baseline data. Some of these technologies are described in the following sections. When the internal combustion engine, and later the automobile, was first introduced to the public, no one could have seen the extent to which they would influence daily life. Today, with information age in full swing, it is still hard to believe the way that computers and other information technology have permeated people's lives and seems only natural to expect information technologies to enhance the way we view automobiles.

People now take for granted automotive systems like emission control and fuel injection. Recent advances in vehicle electronics have led to a move towards fewer, more capable computer processors on a vehicle. A typical vehicle in the early 2000s would have between 20 and 100 individual networked microcontroller/ Programmable logic controller modules with non-real-time operating systems. The current trend is toward fewer, more costly microprocessor modules with hardware memory management and real-time operating systems. The new embedded system platforms allow for more sophisticated software applications to be implemented, including model-based process control, artificial intelligence, and ubiquitous computing. Perhaps the most important of these for Intelligent Transportation Systems is artificial intelligence. In fact, many people do not realize many systems inside their automobile are already monitored and controlled by computers. Fuel delivery, ignition, emission, air-conditioning, and automatic transmission system are example of the systems used daily by a car that are computer controlled or assisted. An articulation of automated car is shown in figure 1.Now in the information age, people have come to realize on the other driver assistance technologies, such as mobile phones and in-vehicle navigation systems.

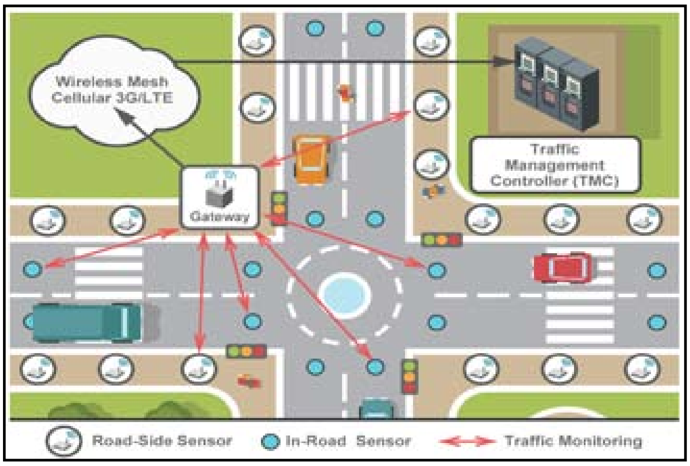

Fig.1: Smart Transportation

The goal of these technologies is to make the experience of driving fewer burdens, especially on long trip. Even when cars were still young, future began to think about vehicles that could dive themselves without human help. Perhaps the best known of these conjectures was the "General Motor Futurama" the hit of the 1939 New York World's Fair [2]. During the following decades interest in automated vehicles rose and fell several times. Now at the start of the new century, its worth taking a fresh look at this concept and asking how automation might change transportation and the quality of our lives. Automating the process of driving is a complex endeavor. Advancements in information technology of the past decade have contributed greatly, and research specifically devoted to the design of automated highway system has many specific contributions. These progresses make it possible for us to formulate operational concepts and prove out the technologies that can implement them.

II. Review of Literature

We can now readily visualize your trip on an automated highway system. Imagine, leaving work at the end of the day and needing to drive only as far as the nearest on-ramp to the local automated highway. At on-ramp you press a button on your dashboard to select the off-ramp close to your home and then relax as your car's electronic systems, in cooperation with roadside electronics and similar systems on other cars, guide your car smoothly, safely and effortlessly towards your destination [3]. En-route you save time by maintaining full speed even at rush-hour traffic volumes. At the end of the off-ramp you resume normal control and drive the remaining distance to your home, better rested and less stressed than if you had driven the entire way. The same capability can also be used over longer distances, e.g. for family vacations that leave everybody, including the "DRIVER" relaxed and well-rested even after a lengthy trip in adverse weather. Although many different technical developments are necessary to turn this image into reality, none requires exotic technologies, and all can be based on systems and components that are already being actively developed in the international motor vehicle industry. These could be viewed as replacements for the diverse functions that drives perform every day: observing the road, observing the preceding vehicles, steering, acceleration, braking, and deciding when and where to change course.

III. Surveillance of The Road

Cheap permanent magnets are buried at four-foot intervals along the lane centerline and detected by magnetometers mounted under the vehicle's bumpers. The magnetic-field measurements are decoded to determine the lateral position and height of each bumper at accuracies of less than a centimeter. In addition the magnet's orientations (either North Pole or South Pole up) represent a binary code [4] (either 0 or 1), and indicate precise milepost location along the road geometry features such as curvature and grade. The software in the vehicle's control computer uses this information to determine the absolute position of the vehicle, as well as to anticipate upcoming changes in the roadway [6-15].
Other researchers have used computer vision system to observe the road. These are vulnerable to weather problems and provide less accurate measurements, but they do not require special roadway installations, other than well-maintained lane markings. Both automated highway lanes and intelligent vehicles will require special sensors, controllers and communications devices to coordinate traffic flow. A national automated highway consortium is depicted in figure 2.

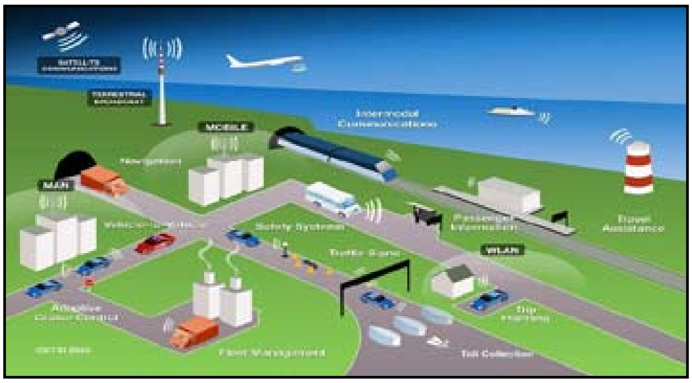

Fig. 2: Smart Cities of The Future

IV. Activities on Observation

The distance and closing rates to preceding vehicles can be measured by millimeter-wave radar or a laser rangefinder. Both technologies [5] have already been implemented in commercially available adaptive cruise control system in Japan and Europe. The laser systems are currently less expensive, but the radar systems are more effective at detecting dirty vehicles and operating in adverse weather conditions. As production volumes increase and unit costs decrease, the radars are likely to find increasing favour.

V. Research Challenges

The equivalents of these driver muscle functions are electromechanical actuators installed in the automated vehicle. They receive electronic commands from the onboard control computer and then apply the appropriate steering angle, throttle angle, and brake pressure by means of small electric motors. A sketch of automated communication is given in figure 3. Early versions of these actuators are already being introduced into production vehicles, where they receive their commands directly from the driver's inputs to the steering wheel and pedals. These decisions are being made for reasons largely unrelated to automation. Rather they are associated with reduced energy consumption, simplification of vehicle design, enhanced case of vehicle assembly, improved ability to adjust performance to match driver preferences, and cost savings compared to traditional direct mechanical control devices [16-24].

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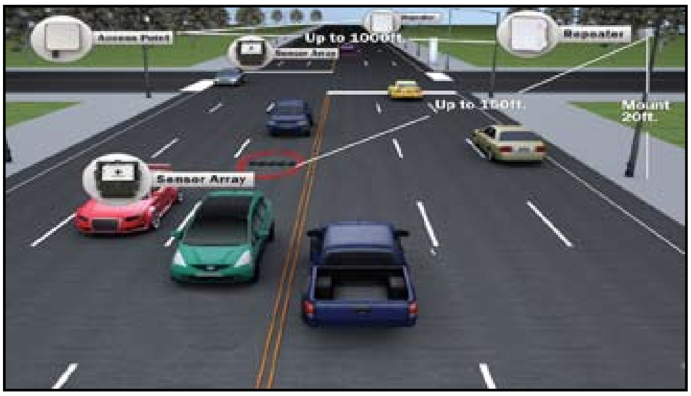

Fig. 3: MEMS sensor solutions

Computers in the vehicles and those at the roadside have different functions. Roadside computers are better suited for traffic management, setting the target speed for each segment and lane of roadway, and allocating vehicles to different lanes of a multilane automated facility. The aim is to maintain balanced flow among the lanes and to avoid obstacles or incidents that might block a lane. The vehicle's onboard computers are better suited to handling decisions about exactly when and where to change lanes to avoid interference with other vehicles.

Some additional functions have no direct counterpart in today's driving. Most important, wireless communication technology makes it counterparts in adjoining vehicles. This capability enables vehicles to follow each other with high accuracy and safety, even at very close spacing, and to negotiate cooperative maneuvers such as lane changes to increase system efficiency and safety. Any failure on a vehicle can be instantly known to its neighbors, so that they can respond appropriately to avoid possible collisions.

In addition there should be electronic "check -in " and "check-out " stations at the entry and exit points of the automated lane, somewhat analogous to the toll booths on close where you a ticket at the entrance and then pay a toll at the exit ,based on how far you travel on the road at checking station ,wireless communication between vehicles and road side would verify that the vehicle is in proper operating condition prior to its entry to the automated line .similarly, the check out system would seek assurance of the drivers readiness to resume control at the exit the traffic management system for an automated highway would also have broader scope than today's traffic systems, because it would select an optimal route for every vehicle in the system ,continuously balancing travel demand the system capacity ,and directing vehicles to follow those routes precisely [25-29].

Most of the functions have already been implemented and tested in experimental vehicles. All except for check-in, check-out and traffic management were implemented in the platoon-scenario demonstration vehicles of demo'97 .a single116 megahertz Pentium computer handled all the necessary in vehicle computation for sensing , control and communications .

VI. Research Insights

The technical challenges that remain to be mastered to be involve software safety, fault detection, a malfunction management. The state of the art of soft ware design not yet sufficiently advanced to support the development of soft ware that can be guaranteed to perform correctly in safety–critical application has complex road vehicle automation excellent performance of automated vehicle control system has been proven under normal operating conditions, in the absence of failures. Elementary fault detection and mall function management systems have already being implemented to address the most frequently encounter fault conditions, for use by well trained test drivers. However, commercially implemented will need to address all realistic scenarios and provide safe responses even when the driver is a completely untrained member of the general public. Significant efforts are still needed to develop system hardware and software designs that can satisfy these requirements.

VII. Design Clallenges

The non technical challenges involve issues of liability, costs, and perception. Automated control of vehicles shifts liability for most crashes from the individual driver (and his or her insurance company) to the designer, developer and vendor of the vehicle and roadway control systems. Provided the system is indeed safer than today's driver-vehicle highway system, overall liability exposure should be reduced. But its costs will be shifted from automobile insurance premiums to the purchase or lease price of the automated vehicle and toll for use of the automated highway facility.

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Given all of this experience in implementing safety-critical automated transportation systems, it is not such a large leap to develop road vehicles that can operate under automatic control on their own segregated and protected lane. That should be a realistic goal for the next decade. The transportation system will thus gain substantial benefits from the revolution in information technology.

VIII. Major Components

The IR proximity detector uses same technology found in a TV remote control device. The detector sends out modulated infra-red light, and looks for reflected light coming back. When enough light is received back to trigger the detector circuit, the circuit produces a high on the output line. Light in the form of a continuous string of bursts of modulated square waves. Bursts alternate between left and right LEDs. A microprocessor generates the bursts, and correlates the receiver output to burst. The IRPD had used Panasonic Pna4602M IR sensor coupled with two IR LEDs to detect obstacles. The Panasonic module contains integrated amplifiers, filters and limiter. The detector responds to a modulated carrier to help eliminate background noise associated with sunlight and certain lighting fixtures. The LEDs are modulated by an adjustable free running oscillator. The sensitivity of the sensor is controlled by altering the drive current to LEDs. The microcontroller alternatively enables the LEDs end checks for a reflection. As provided from the microcontroller one for enabling the left IR LED the second for enabling the righter LED. A third analog output from the IRPDKIT is connected to an analog-to-digital convertor. The detector is an infrared reflective sensor that can be attached to the front of the car to follow a white line on a black background, or vice versa.

There are three reflective sensors, which are made from one piece of infrared LED and photo detector that are directed at the surface bellow the vehicle. Each of the sensors looks reflected IR light. When one of the sensors is positioned over dark or black surface its output will be high. The line detector works effectively when thickness ranged between "1/4 to 3/4" the track can be white tape on a black background or black tape on a white background. The sensor can be at a maximum height of .5 inches above the ground. The three IR-Detector pairs are depicted on the right of the circuit diagram. The base of each of the transistors is passed through an inverter. The lines from the inverter are passed to microcontroller and to the LEDS indicating the position of the detector on the road. As the emitted light from the IR LED is reflected from the road back to the transistor the current starts flowing through the emitter making the base low. The base is connected to the inverter which causes the line to go at its output. Since the output lines are also connected to the LEDs the corresponding LED glows when the particular output line is high.

IX. Major Devices

A servo comprises of control, a set of gears, a potentiometer is connected to the motor via gear set a control signal gives the motor a position to rotate to and the motor starts to turn. The potentiometer rotates with motor and as it does so it does so its resistance changes. The control circuit monitors its resistance, as soon as its reaches its appropriate values the motor stop and the servo is in correct position. A servo is a classic example of a closed loop feedback system. The potentiometer is coupled to the output gear. Its resistance is proportional to the position of the servo's output shaft (0 to 180 degrees)

X. Conclusion

National Highway Traffic and Safety Administration is an ongoing research on collision avoidance and driver/vehicle interfaces. AHS was a strong public/private partnership with the goal to build a prototype system. There are many things that can be done in the vehicle, but if we do some of them on the roadway it will be more efficient and possibly cheaper. Preliminary estimates show that rear-end, lane-change, and roadway-departure crash-avoidance systems have the potential to reduce motor-vehicle crashes by one-sixth or about 1.2 million crashes a year. Such systems may take the form of warning drivers, recommending control actions, and introducing temporary or partial automated control in hazardous situations. AHS described in this paper is functional there is much room for improvement. More research is needed to determine if any dependencies exit that influence velocity of the vehicle maintaining proper following distance while following a path. Assuming such system is ever perfected, one would imagine it would tend to render the great tradition of the free-ranging car into something approaching mass –transit. Future works will be concentrated on developing a real-time hardware for this proposed system.

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