Why are we here?

We are here to serve the students and knowledge seekers throughout the world.

Contact: Infoshare.silverforum.net@gmail.com
PERVERSIVE COMPUTING

[GET YOUR CAR A CONNECTED ONE]
PERVASIVE COMPUTING

[GET YOUR CAR A CONNECTED ONE]

ABSTRACT:

Computing is no longer a discrete activity bound to a desktop; network computing and mobile computing are fast becoming a part of everyday life and so is the Internet. Rather than being an infrastructure for computers and their users alone, it is now an infrastructure for everyone. We expect devices like PDAs (Personal Digital Assistants), mobile phones, offices PCs and even home entertainment systems to access information and work together in one integrated system and the challenge is to combine these technologies into a seamless whole and on the Internet.

The aim of Pervasive Computing is for computing available wherever it is needed. It spreads intelligence and connectivity to more or less everything. So conceptually, ships, aircrafts, cars, bridges, tunnels, machines, refrigerators, door handles, lighting fixtures, shoes, hats, packaging clothing, tools, appliances, homes and even things like our coffee mugs and even the human body and will embedded with chips to connect to an infinite network of other devices and to create an environment where the connectivity of devices is embedded in such a way that it is unobtrusive and always available.

Cars seem to become more and more sophisticated, in terms of mechanics and electronics. This paper reviews the state-of-art pervasive computing utilized in modern car technology. Microprocessors can be found in almost any subsystem of a car, and the applications of embedded computers in enhancing the qualities of cars are discussed in this paper. In addition, it also describes some possible pervasive computing applications in cars and the problems to implement and deploy them are discussed as well.
It is natural to apply the pervasive computing approach to car technology, since car is considered as an indispensable part of modern life. Currently, there are many embedded computers scattered around a car, such as airbag automatic reflection system, ABS system and central locking system. However, with the further development of IC technology and communication technology, more and more computing power can be integrated into a single chip and thus a car will embrace more capabilities to make the driver enjoy better performance, comfortableness, safety and security.

This paper also describes how pervasive computing is used in car to find free space for parking the car. This implementation can reduce the work of driver, time and fuel. This Advanced Parking System (APS) is most prominent in highly dense areas, where the search for parking is congests and interrupts traffic flows. In addition, it also describes what are all the problems when pervasive computing is implemented in cars.
PERVASIVE COMPUTING

(GET YOUR CAR A CONNECTED ONE)

INTRODUCTION:

The information age was born a scant 50 years ago and with the realities of Moore’s Law – is already permeating our way of life. Now we are entering the age of the Pervasive (or ubiquitous) computing which is a concept based on a vision described by Mark Weiser nearly a decade ago. The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it so began Mark Weiser’s seminal 1991 paper that described his vision of ubiquitous computing, now also called pervasive computing. The essence of that vision was the creation of environments saturated with computing and wireless communications capability, yet gracefully integrated with human users. Many key building blocks needed for this vision are now viable commercial technologies: wearable and handheld computers, high bandwidth wireless communication, location sensing mechanisms, and so on.

WHAT IS PERVASIVE COMPUTING:

Pervasive computing is the trend towards increasingly ubiquitous connected computing devices in the environment, a trend being brought about by a convergence of advanced electronic and particularly, technologies and the Internet. Pervasive computing devices are not personal computers as we tend to think of them, but very tiny even invisible devices, either mobile or embedded in almost any type of object imaginable, including cars, tools, appliances, clothing
and various consumer goods - all communicating through increasingly interconnected networks.

**Pervasive Computing**

**HOW PERVERSIVE COMPUTING DIFFERS FROM TRADITIONAL COMPUTING:**

These connections are fundamentally unlike those we associate with networks. Rather than using the network to connect computers that are being used directly by people, these appliances communicate over networks such that people do not directly monitor the communication between machines and programs. The majority of these communications will occur in an **end-to-end structure** that does not include a human at any point.
The number of machines connected to the Internet has been increasing at an exponential rate and will continue to grow at this rate as the existing networks of embedded computers, including those that already exist within our automobiles. The kinds of devices that will be used to access the Internet are no longer confined to desktops and servers, but include small devices with limited user interface facilities such as cell phones and PDA’s wireless devices with *limited bandwidth*, computing power, electrical power and embedded processors with severe limitations on the amount of memory and computing power available to them. Many of these devices are mobile, changing *not only geographic position*, but also their place in the *topology of the network*.

Unlike traditional Desktop Computers and existing networks, the new devices will have the following characteristics:

* Many will have small, inexpensive processors with limited memory and little or no persistent storage.
* They will connect to other computing elements without the direct intervention of users.
* Often, they will be connected by wireless networks.
* They will change rapidly, sometimes by being mobile, sometimes by going on and offline at widely varying rates. Over time, they will be replaced or fail far more rapidly than is now common.
* They will be used as a source of information, often sending that information into the center of the network to which they are attached.

**THE ADVANTAGES OF PERVERSIVE COMPUTING:**

We increasingly depends on the transmittal of personal, financial and other confidential information, which demand the highest security for all these
transactions and require complete access to time-sensitive data, regardless of physical location. We expect devices personal digital assistants, mobile phones, office PCs and home entertainment systems to access that information and work together in one seamless, integrated system. Pervasive computing gives us the tools to manage information quickly, efficiently, and effortlessly.

Pervasive computing aims to enable people to accomplish an increasing number of personal and professional transactions using a new class of intelligent and portable appliances or "smart devices" embedded with microprocessors that allow users to plug into intelligent networks and gain direct, simple, and secure access to both relevant information and services. It gives people convenient access to relevant information stored on powerful networks, allowing them to easily take action anywhere, anytime.

Pervasive computing simplifies life by combining open standards-based applications with everyday activities. It removes the complexity of new technologies, enables us to be more efficient in our work and leaves us more leisure time and thus pervasive computing is fast becoming a part of everyday life.

APPLICATIONS OF PERVERSIVE COMPUTING:

- Cars
- Mobile phones
- Handhelds
- Households appliances
- Smart machines
- Wearable computers, etc..
In the fast world, Car plays a major role in our day-to-day life. This paper reviews how the quality of car will be enhanced by means of pervasive computing by implementing microprocessors chips in almost all the sub-systems of the car and also how pervasive computing will be used to sense the presence of free space in parking areas.

It is natural to apply the pervasive computing approach to car technology, since car is considered as an indispensable part of modern life. Currently, there are many embedded computers scattered around a car, such as air-bag automatic reflection system, ABS system and central locking system. However, with the further development of IC technology and communication technology, more and more computing power can be integrated into a single chip and thus a car will embrace more capabilities to make the driver enjoy better performance, comfortableness, safety and security. In the near future, we will definitely see more microprocessors installed in a car, because emissions and fuel-economy standards requires more sophisticated engine control, and exhaustive diagnostics are needed as well as the demanding for safety, comfort and convenience features keeps rising.
From drivers perspective, the application of microprocessors can provide better security, safety, comfortableness and convenience. Besides from these features, however, carmakers have great concerns about utilizing embedded computers to facilitate the car design, such as real-time car diagnostics, simplified wiring and smart engine development. There can be as many as 50 embedded computers inside a modern car, it is thus impossible to cover all the applications of computers in car in such a short paper. This sector only discusses some major applications that already used or will be used inside a car.

➤ SECURITY

Every year people around the world invest billions of dollars into buying new cars and for most people car becomes an important and expensive investment around one’s life, which makes car become the best candidate target of thefts. According to survey, for every 20 seconds a car is stolen in Europe, thus people are willing to install car security system to protect their car from stealing and vandalizing.

Car security system has three functions to warn away, to alert and to provide. If somebody attempts to vandalize or steal the vehicle, the system will try to warn him away from the vehicle, by flashing LED or giving out some sound. The second stage involves alerting the owner of the car that somebody is trying to enter the car, steal the wheels or damage the car. Strobe lights or voice response are traditional means used to alert the owner from a distance.

Some modern alarm systems also use pagers or cellular phones to do the job. The last function is to provide convenience to the driver, including central doors locking, power windows and remote starts. Basically, the typical car security system provided by these vendors consists of a series of sensors being
installed around the windows, wheels or engine, and one or multiple embedded computers control those sensors.

A highly advanced technology in modern car security system is called **G4 Technology** from Clifford Electronics, which is evaluated as the first digital network security systems. G4 Technology provides the capability to connect different alarm components with an underlying network called **CliffNet**. With CliffNet, all the security components inside the car could communicate in a daisy-chain way with each other in real time. Another highlight of G4 Technology is it permits the owner to plug any Microsoft Windows-based PC into the CliffNet and run exhaustive diagnostic tests and configuration based on it.

➢ **SAFETY**

“Does it have ABS?” This might be the most common question of nowadays car buyers ask when they want to know something about a car. ABS, the abbreviation for Antilocking Break System, used to be a privilege exclusive for luxury cars several years ago, now becomes the standard configuration of a middle class car. While a car is slowing down, ABS can keep the wheels from skidding. With the help of ABS, drivers can stop the car faster, and steer while breaking, which is extremely useful when driving over sliding surfaces.

ABS system typically has four components: **speed sensors, a pump, valves and a controlling computer**. The controlling computer monitors the speed sensors continuously, and when abnormal decelerations of the wheels happen suddenly, the computer knows it is impossible for the car to perform it, because it will result in the spin of the car. As a response, the computer will reduce the pressure until it sees the decelerations again. This way the tire slows down at the same rate as the car itself and the car will gain maximum breaking power.
Airbag is another standard configuration for modern cars. Since the model year 1998, all new cars have been required to have airbags on both driver and passenger sides in some European countries. It is expected in a few years, cars will possess six or even eight airbags to provide maximum protection for drivers and passengers.

An airbag consists of three parts: the bag itself, which is made of nylon fabric, the sensor detecting the crash, and the inflation system inflating the bag. Restrictively, there is no independent computer involved in airbag system; however, the crash sensor could be an electronic sensor which use an accelerometer, which is basically a tiny computer, etched on a silicon chip.

➢ COMFORTABLENESS AND CONVENIENCE

To make the driving a comfortable experience is always the goal of carmakers. For many years, more and more innovations are applied to car technology to make people feel better when they are driving. With the help of
digital devices, carmakers have no limit to pack new technologies into the car. An interesting feature of car is the navigational system, which can provide the real time location information of the car.

In-vehicle navigational system includes a GPS receiver, which receives the location information from the GPS satellites orbiting around the earth. The GPS receiver is basically an embedded computer, which provides decent computing power and a LCD display. With the help of preinstalled digital map inside the GPS receiver, drivers know the exact location of themselves at any time. This is extremely useful for those people who travel a lot by car.

Car rent companies will also benefit from this technology because they can track the location of their cars. During the last 40 years, radio, tape recorder and CD players are the only entertainment equipments of ordinary cars. Few luxury cars have televisions, but they are unaffordable for ordinary people. Digital music opens a new door to the car entertainment with low power consumption and affordable price.

➢ TELEMATICS

Americans spend 26 billion hours a year in their cars. Most of the time, they are blocked in traffic, without doing any productive works. With the advances in telecommunication technology, people are able to make the car to become a communication platform, through which drivers can trade stocks, read and answer emails, set up schedules, plan an appointment or even order groceries online and listen music online.

General Motor’s Onstar system was the first integrated information service platform introduced in 1996. Basically, OnStar is a service network, which connects cars to the service center constantly. Various wireless
technologies are used in Onstar system. It evaluates the position of car using the Global Positioning System, while the communication with assistance center is done through a cellular network, which takes care of both voice and data transfer. The telephone operator is the main control subsystem of Onstar system, which knows exactly where the driver is calling from and can guide the driver to the destination.

A sensor connected with the inflatable bag will inform the service center whenever the airbag inflates, indicating a car crash happens. The call from the vehicle delivers the location information and opens the voice connection with OnStar advisor. When advisor receives the automatic call, he will try to make voice contact with the driver. Depending on the driver’s situation, the advisor will call service provider, police or even emergence operator to reach the driver and offer help.

New version of OnStar would be equipped with a new feature called Virtual Advisor, a speech-recognition based system, which could retrieve information like e-mail, news, stocks quota, sports and weather. Besides, Virtual Advisor could provide real-time traffic information, guiding the drivers to avoid the heaviest traffic routines.

*Figure 4. OnStar system in operation*
ADVANCED DIAGNOSTICS AND CONTROL

For years, effective car diagnostics are dependent of the maintenance personnel experience. People are quite puzzled by the irreparability of some car problems i.e., when the driver send the car to service after breaking down, he might not be able to reproduce the problem again. On the other hand, even when the problem is repeatable, it often takes the maintenance people quite long time to identify the source of trouble, because the car itself is very sophisticated and many parts are connected with each other.

Computer-based automatic diagnostics system may ease the problems. In such a system, the centralized computer samples the signals from different parts of the whole car and monitoring the status of these parts. Whenever abnormal signals are detected, the diagnostic computer will notify the driver and stores the status. Technicians can easily track the problem by reading the data stored in diagnostic computer.

Engine Control Unit (ECU) is probably the most powerful computer on most nowadays cars, because controlling the engine is the most processor-intensive job on a car. After the enactment of emission laws, car engines are required to be built with limited emission while keeping enough power, which can be impossibly done without the introduction of microprocessors. The ECU uses close-loop control scheme to monitor the engine and manage the emissions and fuel economy.

By well-adjusted algorithms, the computer can keep components of car engine in good condition and record abnormal behaviors of the engine which could be used as a reference for future maintenance and engine design.
SIMPLIFIED WIRING

We all know a car is a complex combination of mechanical, electrical and electronic components. To connect all the electronic and electrical components, wires are indispensable. In current vehicle system, communication between different components in a car is handled via a dedicated wire through point-to-point connections. Traditionally an electronic device in car is connected to the controller or computer through individual wires, which results in huge number of wires mixing around the car. This kind of wiring is most likely to cause problems because wires are easy to damage and erode in a car’s lifetime, which degrades the reliability of a car.

In-vehicle networking, also known as multiplexing, provides a more efficient method to alleviate this complexity. In-vehicle network provides a centralized In-vehicle CAN bus, to which each electronic module is connected. Communication between components is routined through this single bus, which replaces the bundle of wires around the car.
In-Vehicle networking brings many benefits in system levels. First, the system cost, weight, reliability and installation are improved dramatically, because the number of dedicated wires decreases, and thus the size of wiring harness reduces. Second, some common sensor data, like vehicle speed, engine temperature, are shared on the network, which eliminates the need for redundant sensors. Last, functions can be added through software upgrading, and the networking provides great flexibility in car design.

Now, let us see how pervasive computing is used in **PARKING SYSTEMS**

- **ADVANCED PARKING SYSTEMS (APS)**
  
  Advanced Parking Systems get information about available parking spaces, process it and then present it to drivers by means of variable message signs (VMS).

  APS is used in two ways:
  - to guide drivers in congested areas to the nearest parking facility with empty parking spaces
  - to guide drivers within parking facilities to empty spaces.

  Although the former function is more common, guidance systems within parking lots are becoming more common. This growing number of guidance systems addresses drivers need for more information about the position and number of the spaces that are actually available within a parking structure. These systems reduce time and fuel otherwise wasted while searching for empty spaces and helps the car park operate more efficiently.

  The need for APS is most prominent in highly dense areas, where the search for parking facilities congests and interrupts traffic flows.
PARKING GUIDANCE SYSTEMS

Basics of Parking Guidance System:

These systems are based primarily on the use of message signs to give drivers information regarding parking availability. The availability of parking spaces in each facility is obtained from sensors that count the number of cars entering and exiting or in other cases by comparing the tickets issued at machines or cash registers to the capacity of the facility.

This information is sent to a central or main computer that processes it determining the locations of available parking. Availability is generally expressed in terms of full or empty but in some cases the actual number of spaces is given.

A problem with showing actual numbers is that when the number is small, drivers tend not to enter because they think that all of the spaces will be taken by cars already in the facility. This would not actually happen because the availability takes into account cars that have already entered the facility. The systems include VMS that show parking availability and nearest parking facilities.

In some cases static signs guide drivers to the facilities. Other means of providing availability information are via roadside radio terminals, where small static VMS show the frequency at which it is being broadcast or by phone where automated answering machines can give information on congestion and parking availability through Internet.

Benefits of Advanced Parking System:

- Reduction in time spent and fuel consumed while searching for available parking space.
- Reduction in congestion due to fewer cars driving around searching for spaces.
• Elimination of queues entering parking facilities because drivers will not go to a facility where there is no available space.
• Reduction in illegally parked vehicles.
• Better distribution of flow and parking demand through the area.
• APS systems result in higher revenues and profitability for the parking facilities.

**Examples of APS:**

*In US*

**St. Paul, MN**

The system in St. Paul was designed to improve traffic and ease the search of parking in downtown. It interconnects 10 different parking facilities in the downtown area. A central computer system obtains information from each facility, processes it, and sends it to LED-based VMS. It uses 56 signs to provide information on parking availability. From these, 46 are static signs, used as "wayfinders" to guide drivers to the facilities.

*In ASIA*

**Yokohama, Japan**

This dense city of 3 million has introduced a system that provides drivers with the current status on parking and guides them to parking facilities. It includes 16 parking lots with 4,400 parking spaces. This project was a joint effort by the government and private parking facility Operators. The system divides the city in four concentric zones. In the first zone, drivers enter the city and are notified of parking availability via detailed information on boards. When entering zone three, a board shows directions to parking facilities. Finally, a board at the entrance displays the name of facility and space availability.
PROBLEMS AND CHALLENGES

It looks like people will never stop inserting more and more computing powers into a car, and the only limitation is imagination. However, there are some technical and political restrictions that constrain some applications of computer inside a car.

➢ ELECTRIC INTERFACE COMPATIBILITY

Currently, there isn’t a single standard for electric and electronic interface for car computers, partly because very manufacturer wants to protect their proprietary systems. The lack of compatibility between different vendor’s systems makes it difficult for the customer to select proper devices according to their own favorites.

The addition of new electronic features, like Hi-Fi audio, video, requires higher voltage. On current car systems, the voltage is 14V, and the carmakers are planning to increase it to 42V. However, to keep the compatibility of old electronic appliances in car, there should be converters that can provide both voltages. The introduction of converters will inevitably increase the complex and thus degrade the reliability of car.

➢ RELIABILITY

Reliability is another issue that should be considered intensively when applying a computer to car. As discussed before, some computers are used in the breaking system, air bag system and collision avoidance system. These computers are required to be highly reliable, because the malfunction of these computers may lead to fatal result, even loss of life.

In aerospace industry, reliability could be ensured by introducing redundancy, that is, using back-up system whenever the major system doesn’t
work. However, a car cannot leave much room for redundant systems, and the cost is another issue when applying redundancy.

➢ Driving Distraction

For years, driving distraction is the major cause of car accidents. With the introduction of telematics system in car, drivers can make a phone call, browse the web or even watch movies when driving. However, more and more people are concerning about the fact that what people doing behind the wheel will definitely distract the attention from looking at the road, and accidents will most likely happen. Researchers found using mobile phones during driving causes people distracted, and recommended that cell phones should be banned on the road. However, car manufacturers don’t accept this, and they claimed at least hand free calling would not distract the driver’s attention. Nevertheless, some government have legislated to ban the using of cell phone while driving

CONCLUSION:

The introduction of computer into car technology provides better security, safety, comfortableness and conveniences for drivers. For car manufacturers, in-vehicle computers also provide flexibility in car design, and efficiency in car production. However, there are some limitations that stop the massive applications of computers to cars, and there is still a long way to go.

People will never stop inserting more computers into a single car, and concepts cars are good test beds for those advanced applications. In the future, we will definitely see more and more computers inside a car, making the car to be more intelligent, safe and comfortable to drive.