ICT Integration for Electric Vehicles as Data Collector and Distributor of Data Services

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Abstract- At present, automotive companies are very interested in information communication technology (ICT), electric vehicle sensors, and their associated intelligent transport systems (ITS) applications. The production of in-vehicle sensors is developing continuously because of their proven benefits in preventing accidents, improving driving efficiency, and collecting data for sensor-based services. These advantages are not only limited to the vehicle's driver but also to the drivers of other vehicles and web database server as third parties. In this paper, we present Vehicle as a Data Collector and Distributor (VADCD), a concept that explains how a sensor-equipped vehicle can be considered as a pivotal, mobile source of sensory data and sensor-related applications and services.

Keywords: *automotive industry, electric vehicle, information communication technology (ICT), sensor.*

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1. Introduction

The appearance of ICT, such as in wireless communications technology, mobile apps, sensors, web-based tools,mapping, and Global Positioning System (GPS), have brought about significant leaps in transportation data collection and management practices. On a combination of these technologies. Therefore, the advances in the automotive industry are highly dependent on the deployed in-vehicle sensors that are currentlyconsidered necessary elements of any vehicle regardless of its class. Sensors improve a vehicle's performance, monitor its service and the status of its parts, and heighten driving skills. As the desire for more automotive advances is rising, the number of sensors in the vehicle are rapidly rising, as well. [1] According to the automotive sensors market increase in the world. Currently, a recreation vehicle has an average of sensors for verifying its service and enhancing its in-vehicle services [2]. Some of these sensors are combined to vehicles, and another is added for providing higher competence and convenience. Having this large number of sensors, a vehicle can be considered a primary resource of sensory data that are difficult to obtain from a single sensorysystem or network. Moreover, it replaces conventional data collection methods. In this paper, we aim to clarify the significance of in-vehicle sensors and data collecting, the services they can include, and the systems/applications they can be part of by introducing the idea of a vehicle as it collects data and sends for others. The current trend in the global automotive industry's service mobility will continue to grow as such in the future. Improvements to service should be implemented simultaneously to lessen range anxiety [3]. The architecture and role of ICT will change for the vehicle of the future. The use of ICT enables bidirectional flows of data between these component systems and facilitates two-way communication and control capabilities to support efficiency, availability, and robustness. Connected and autonomous vehicles will generate vast amounts of data. Therefore, users can share such data. This implies the need to open up a range of opportunities for consumer engagement and monetization for the data owner. This will become a source of competitive advantage for the electric vehicle [4]. This reduces the cost of the vehicle in case some companies pay for the service provided by a good owner, such as Google, to update maps. It will bring about significant economic and environmental benefits to users.The complex of this paper is organized as following: The electric vehicle is described In Section 2. EV as the Data Collect Concept is presented. In Section 3. The electric vehicle as Data Collection, Application, and Platform are explained in section 4 Sensors are viewed In Section 5. Communication technology in electric vehicles In Section 6 Wireless Communication Technology used in an electric vehicle. In Section 7. Data center servers. In Section 8. the ICT future in EV In Section 9. Finally Conclusions in Section 10.

2. Electric Vehicle

The electric vehicle (EV) is an alternative transportation option that emits zero exhaust gasses and generates minimal noise. EVs use an electric motor and battery energy for propulsion, which has higher efficiency and lower operating cost than conventional internal combustion engine vehicles. The continual development of lithium ion battery and fast charging technology will be the major facilitators for EV rollout in the near future [4,5]. New international roadmaps for reducing CO2 emissions are being accompanied by substantial financial investment in the development of sustainable transport. A large amount of funding has been allocated to private investors and governments to finance the development of renewable energy and multimodal transport systems that are energy-efficient and use cleaner fuels (MDB working group on sustainable transport progress report, 2013; United Nations, 2012)[5]. In this context, the electric vehicle (EV) is a relevant mode of transport: it is a practical alternative to conventionally-fuelled vehicles if the production of electricity used is not polluting. This has resulted in the provision of government incentives (Valls, Royal, Sapin, Macron, & Eckert, 2014) to make the purchase of EVs more attractive (e.g., in France in 2015, a 6300 euro bonus increasing to 10,000 euros if associated with the destruction of an old diesel vehicle, against a 5000 euro bonus in 2011), and an increasingly varying range of

EV models being offered by manufacturers to meet the specific needs of users, for both private and fleet vehicles (vehicles with 2 or 5 seats, varying range, etc.).The electric vehicle is viewed by many as an acceptable way to enhance the environmental features of road transport. Most prominently, they could play a significant function in reducing road traffic and carbon emissions [5].

3. EV as the Data Collect Concept

Real data are currently gaining more .engagement with advantages in terms of global data sharing and access. Thus,thefocus of development is on vehicle transportation and other abilitieand services related to the manufacturing and use of sensors available in portable telephones and other handheld devices for sensing the data and utilizing the communication interfaces in these devices for distributing data that are of interest to others. This has opened doors to many new application domains. The combination of global navigation satellite systems, such as GPS, with digital maps creates a deep range of applications for electric vehicles[7]. Such systems assist in interpreting the scene around the vehicle and navigating the vehicle in conditions where other sensors are working (Snow, Rain, dust, etc.). Digital maps used for travel are now commonly available. The improvement of digital maps by real-time data about transportation can make traffic more efficient. Other additions to these digital maps include warnings for curves, speed warnings, data signs, etc. Moving vehicles are increasingly used as data sources for various purposes. In a connected vehicle environment, the vehicle subsystem presents the sensory, processing, storage, and communication functions necessary to establish adequate, safe, and convenient travel. These functions reside in various types of vehicles, including automobiles and commercial, emergency, construction, maintenance, and transit vehicles [8]. Advanced sensors, processors, enhanced driver interfaces, and other on-board units (OBU) can record and deliver the data through wireless networks. The data include basic vehicle measures, vehicle safety data, environmental probe data, vehicle diagnostics data, and vehicle emissions data. Specific data elements from connected vehicles include [8].

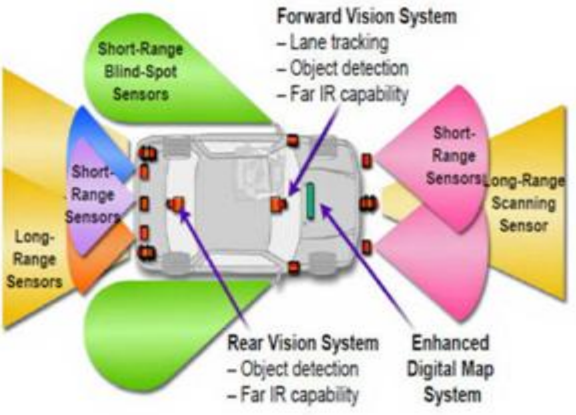

Fig.1: Autonomous-vehicle-sensors [15].

4. EV as Data Collection Application Platform

The numbers of sensors, in a vehicle, are increasing day by day,models and the composition of communication interfaces, such as vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I), which sustain vehicles, have also marked growth in the development of data resource for the external environment; data resource is not only limited to the vehicle inhabitant's use. Vehicles, used as a resource for sensory data, have more advantages than other mobile devices that have been utilized in the interest of urban sensing. Vehicles have no limitations in their power sources, which have been considered as a major barrier to the wide use of portable devices. Vehicles can be provided with powerful processing capabilities that widen the scope of supported applications. Sufficient data storage units can be installed on vehicles, which is a poor comparison to the limited data storage in mobile devices. All these characteristics can enhance the use of a vehicle as a mobile sensor and formulate the concept of electric vehicle collected data [9,7]. Many applications and platforms are being proposed to make use of the advantages of using vehicles as data resources. In these applications, vehicles are related to sense, monitor the enclosing environment, generate data, and store them for more relaying - either without processing or after processing, to search for specific data of attention. Insight data, or processed sensed data, can be communicated to third parties by the Internet and vehicle-to-any (V2X). These third parties can be data servers for data stations that can publish/off er this data for unrestricted or commercial services, or they can be other mobile users/drivers.[6,8] Street/highway sensors can provide some of these services, but measuring them by vehicles is more advantageous. Rather than wasting money and time deploying such specially-installed sensors, in-vehicle sensors can provide the same services with no extra deployment or pay, saving time of deployment, and contributing a great level of availability for interested data retrievers [10]. Examples of some possible applications of the use of a vehicle as a resource of sensing are the other environment monitoring applications. Weather status, street images, and road and traffic situations can be identified by the use of in-vehicle sensors, and such data can be sent to database webserver asthird parties. These sensed data can be processed locally by each vehicle (distributed processing) or at the collecting center (central processing) and then advertised through radio broadcasts, Internet-based applications, and street/highway displays. Sensors in a vehicle are of many different types.

5. Sensors

The vehicle has many different types. Vehicle sensors can fall under two categories:

A. according to their place of deployment in a vehicle:
1. powertrain sensors
2. chassis sensors
3. body sensors

B. according to their application domains:
1. sensors for safety
2. sensors for diagnostics
3. sensors for convenience
4. sensors for environment monitoring [7]

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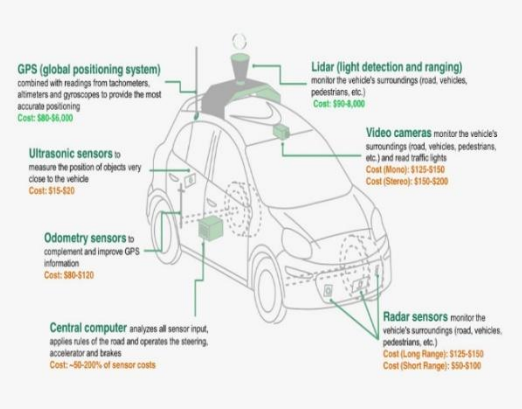

Fig. 2. Sensor information [14].

6. Communication technology in EV

To provide its functions as a resource for sensing, a vehicle should have sensed data generated by its in-vehicle sensors. Such data are utilized by the aforementioned systems/applications, the on-board unit, and the inter-vehicle communication interfaces. Each of the in-vehicle automotive systems is implemented as an embedded system with a controller and a numbersof sensors and actuators that support the required operation of the system. This controller is known as the Electronic Control Unit (ECU). Each ECU consists of a processor, memory, and communication interfaces.
depending on their function The primary networks are Controller Area Network (CAN),Local Interconnect network (LIN), FlexRay, Media Oriented Systems Transport (MOST) , and Ethernet Audio Video Bridging (AVB) [16].

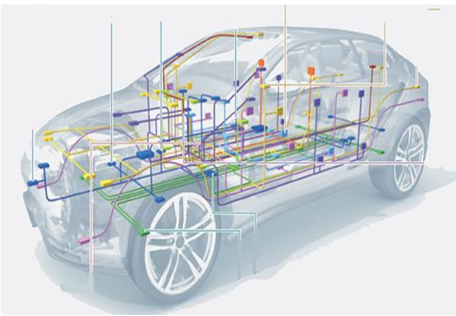

Fig.3.Communication technology in electric vehicles [16]

7.Wireless Communication Technology used in EV

Although wireless communication usually comes with great advantages represented in reduced cost and ease of deployment and use, it is so far not proven to be an efficient communication means for intra-vehicle communications.Manywirelesscommunication technologies can be adopted to get the data out of the vehicle and deliver it to other vehicles or third parties. Examples include the specially developed wireless access for vehicular environment (WAVE) standard, which is based on the IEEE 802.11p standard, and the dedicated short-range communication(DSRC)[10].Another communication facility that is considered a bridge for anywhere connectivity for vehicles is the CALM technology standard, which stands for communication access for land mobiles. CALM supports having an integrated communication unit that provides many air interfaces that include 2G/3G cellular technologies, Infrared, millimeter-wave, mobile wireless broadband (HC-SDMA, 802.16e, and 802.20), satellite, and DSRC. In addition, some Zigbee communication modules are designed to support vehicular communication. Furthermore, the use of visible light communication (VLC) in the vehicular environment is now gaining great interest [8, 10,11].

1. Electric vehicle data to determine vehicle position, etc.
2. Environment data to provide useful data as road, weather, etc.
3. Passenger data To identify the driver

Fig.4. Wireless Communication (v2v, v2i)

8. DataCenter Servers

Data driver, data environment, and data electric vehicle create a broad range of application.The integration of the vision system and global navigation satellite systems, such as GPS with digital maps, makes a widerange of applications for electric vehicles. Such systems help in interpreting the scene around the vehicle. Digital maps used for navigation are now commonly available. The improvement of digital maps by real-time data of traffic can make traffic more effective [8]. Tracking electric vehicle driver to discovering during the accident or engagement of aggression by electric vehicle. The following table shows Future IT Mobility Solutions for “Integrated” and “Interoperable” Transport Infrastructure:

Table1. Future ITS Mobilityfor future electric vehicle.

	Vehicle Access/ Security	Telematics	Electric Vehicles	Navigation	Mobility
1	Vehicle Locator	Emergency Assistance – App	EV Billing	Turn by Turn Navigation	Car Sharing Vehicle Access
2	Vehicle Access – converting phone in to smart key	Real Time Video Traffic Feeds	Interior PreCondition App	Dynamic POI Finder	Car Sharing – Choosing, Reservation and locating cars
3	Remote Car Starter/ Security	Diagnostics – TPMS, service/oil notifications,	Charging Station Locator	Real time Traffic Information	Car/Van Pooling – car and van pooling apps,
4	Remote Vehicle Horn/Light Flash – Security App,	Integrated Telematics – eCall/bCall/	State of Charge Monitoring App	3D Navigation with Video Support	Multimodal Transport – apps for real time bus/transit

9. The ICT Future In E V

The future of EV is very promising. There are many great advantages of EVfor human life. EV has the potential for the technology and business location, as well as for the protection of climate and environment. For example, drive and charging solutions for hybrid and electric vehicles are helping automobile manufacturers around the world to meet their CO2 targets. Electrified city buses make urban traffic quieter, cleaner, and cheaper for operators[12]. Various trends affect the ICT inEV and result in changes. The main potential development of the ICT in EV development is summarized below:

1. Social Trends

A suitable ICT architecture offers a basis for meeting these requirements. Replacing mechanical and hydraulic components with electronic manual (such as "X by wire") reduces vehicle weight and increases safety range.

2. Technological Trends

In technology, there is a trend toward greater miniaturization and toward developing intelligent modules. Highly integrated mechatronic components are evolving that can be integrated into vehicles by way of a data interface. Sensors and actuators are becoming more intelligent and more and more capable of universal use, including for pre-processing and simple adjustment tasks. In software technology, an intermeshing of concepts from safety-critical embedded systems and Internet technology is becoming evident, especially in middleware.

A report identifies three different scenarios for how the automotive industry could manage the upcomingchanges [13]:

2.1. Low Function/Low Cost for 2020

This scenario is the most probable for new market participants focusing on low-cost vehicles. Theehicles' functionality and customers' expectations about comfort and reliability are relatively low. The scenario is well suited for introducing a revised, simplified ICT architecture that includes a drive-by-wire approach; actuator components are connected directly to the power electronics and the ICT. In that way, actuators can draw energy locally and be triggered via software protocols, reducing the amount of cabling and the number of control devices.

2.2.High Function/Low Cost on 2030

In revolutionary ceremony on 2030, ICT has been optimized over the years and is now very atrractionchallange. Even, famer who can be consumed with high expectations buy this kind of vehicle. This trend is reinforced by the ability to integrate new function easily into vehicles, and to customize them. Thoseconsiderations behind scenario are rapidly based on a further development. the ICT revolutionary of electric approach architecture was described by the "Low Function/Low Cost".

2.3. High Function/High Cost

In another difference of the electric scenario addresses electric cars in 2020 whose architecture concept builds very largely on what is already known from conventionalinternalcombustion-engine vehicles. What is primarily electrified in the drive train; the existing ICT architecture is still used with no developmental advances.

10. Conclusions

In this paper, we present a novel conceptual Electric Vehicle as a collector of data and distributor with Sensor (EVCDD) with the objective of providing a comprehensive view of how a vehicle can be considered a significant resource of sensing data. A vehicle as a multi-mobile sensor can be a main key enabler of urban and rural sensing with significant advantages over its counterparts. We showed that services provided by sensor-equipped vehicles could be advantageous for drivers or passengers, but also to other vehicles on the route and data centers. Furthermore, we presented a categorization of in-vehicle sensors that categorizes them based on their application domains, along with some illustrative sensors and their related ITS applications. In addition, we refined some communication technologies that support (EVCDD). Automated vehicles will fundamentally change transportation systems. The societal benefits of these technologies include the reduction of crashes, energy consumption, pollution, and ultimately overall costs associated with the movement of people and goods. The connected and automated vehicle systems will also provide tremendous opportunities to improve the density, accuracy, completeness, and timeliness of data collection from a multisource data environment. While there is still work to be done to develop applications that make use of connected vehicle data for operations, areas of known interest would include: Traffic operations and management, Safety applications, Performance measures, system and system analysis, Travel behavior analysis, traveler information systems, and new transportation services such as a black box in the vehicle which knows the last driver and trip.else ensures a company has the confidence to ensure it, and all businesses attractive for electric vehicle Contribute to decrease the cost to help more spread it, to get Eco-friendly cities

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