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Methods of monitoring Vehicle's CAN data with mobile devices

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Abstract

Informing the drivers are very important for ensuring the traffic flow properly and safely in highway transportation. Mobile devices take part in technologies that support the improvement of intelligent systems in traffic management and control systems which vehicle and way knowledge are shared. Due to the GPS, Accelaration, wi-fi etc. features of smart phones developed by using built-in sensors are prefered to use in traffic. In this study, how diagnostic tool ELM327, which reads data through vehicle network, communicates with mobile devices, what type of software are used for data tracking and which data is transmitted from the vehicle are explained. In smart transportation systems which added the smart phones features , Providing bi-directional communication applications like warning drivers against possible accidents, determining road congestion, communication vehicles each other, sharing and displaying highway knowledge on mobile devices. It is expected that it contribute to the development of systems which enable traffic management and control beside server-based data sharing and informing drivers.

Keywords: CAN Bus, ELM327 Diagnostic, OBD II, Smartphone, TMS, ITS.

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1. Introduction

Nowadays, traffic problems occuring along with the increasing number of vehicles give way to many faults and accidents. Therefore, informing the drivers of and warning them against the possible accidents in highway traffic is of great importance. Service information involving traffic density, road, navigation, emergency services can be shared by means of an information system developed for drivers. Required data for drivers in traffic are retrieved from the vehicle and the sensors nearby. Among the monitoring devices within the driver information systems are road data-boards or portable devices which belong to drivers [1, 2, 3].

During the development process of mobile devices, introduction of several features such as GPS, wi-fi, 3g and acceleration has greatly contributed to advance in various intelligent applications for TMS. Smart phones have made it far easier to share data from different sources in highway transportation and wireless internet service has enabled Access to a remote server. Besides modern vehicles, there are too many vehicles on roads which have no on-board computer. Introduction of smart phones into our lives has been the best solution with regard to data transmission and monitoring of the received data [1, 4, 5].

Vehicles in the management of the electronic control unit are located many features such as energy efficiency, the movement management tool, entertainment. In case of any fault, vehicle interface is needed for communication with the outside world of electronics. A diagnostic device that provides serial communications monitors the data flowing through the vehicle's network via interface update made for modern vehicles [6]. ELM327 Diagnostic device one of the supported device from OBDII (On-Board Diagnostic) in vehicles can provide the network data flow by providing wireless access to mobile devices. OBD port on the vehicle and mobile phones uses bluetooth or wifi connections for wireless data transfer [7].

In order to accomplish such applications some researches consider to use OBD2 and mobile devices. Litreture survay has already been done about these subjects [8]. There are academic researches about congestion control, vehicle to vehicle communications, early warning systems, first aid in case of road accident, traffic control and management systems [9, 10].

802.11p standard that allows wireless access to the roads to support intelligent transport systems is determined by the IEEE. Communication over 802.11p standard for vehicles requires the presence of hardware equipment in each road point [11]. The vehicles must be equipped with DSRC (Dedicated Short Range Communication) technology providing communication of vehicle to vehicle, vehicle to environment. Wireless internet radio frequency communication is preferred to gather information from different data sources in traffic flow. In studies, there is an android based application which supports DSRC inter-vehicle communication technology via wi-fi [11, 12]. Vehicle to vehicle and vehicle to infrastructure communication architectures based on cellular network were examined and evaluation studies were performed in traffic applications gained importance about vehicle to vehicle communication [13].

Smart phones, which plays an important role in intelligent transportation system, are able to make data sharing, vehicle safety, driving safety, road safety and traffic control because they support the web. Studies, which have collected data from various sources different technologies while sailing and contributed to the creation of the database for traffic management and control systems, were carried out [3, 14, 15]. Mobile technology supported studies, which perform information retrieval, transmission and storage operations and prevent traffic accidents with vehicle telematic systems, are carried out [16]. In another study, OBD socket device which established a bluetooth connection with smart phone has been developed and time of entering the service of the driver was informed by email via the Internet [17].

In order to maintain road safety, there have been studies developed to continuously monitor vehicle's network data transmitted to main server using 3G. Preferred smartphones, with their abilities to transmit data wirelessly, can transfer data used in traffic applications to remote servers. In a study, network data and location information sent from a vehicle was saved, transmitted to Internet based servers and displayed over web based servers to further process them. Identification and surveillance was implemented by registering vehicles according to their

unique Vehicle Identification Number (VIN) [18]. In these studies drivers were pre-warned against unexpected accidents and vehicle's error records were saved. In case of a serious accident location of the accident is sent to the nearest emergency service [16, 19]. Data is gathered over OBDII via the ECU system from the emulator application vehicle developed as an alternative to the difficulties of testing with real world situations and tests were made with Android based smart device [20].

In order to improve safety on roads, scheduled repairs and checks of vehicles and also roads; before they are allowed to be used, will reduce most of the predicted risks. Also educating drivers with sufficient information and experience will prevent most of the dangerous situations [21]. In a study, where driving information of the driver and the network and GPS information of the vehicle was recorded, transmission were performed on mobile devices and experts were informed for remote control [22]. There are android based applications that provides safe driving for traffic flow in developed in mobile applications [23]. Due to the reduce excessive speed violations of a group of drivers in the same way as the route, vehicle speed data are received on OBD II and test applications that provide monitoring revealed positive results [24].

The first stage of this study, electronic data bus of vehicles are examined and OBD socket is described that provides to transfer CAN bus data out of the ECU of the vehicle for safety in highways traffic applications. ELM327 scanning device is an interface that provides access to the vehicle's network information, it can be compatible with OBD II protocols. Capabilities and communication protocols of the ELM327 diagnostic device have been investigated. In the second stage of the study, the communication methods of mobile devices thanks to a wireless connection feature with ELM327 diagnostic device are explained and improvable intelligent applications are described to contribute to road traffic management and control. Due to the increase in the usage of smartphones operating on Android and iOS, it is possible in vehicles to perform actions such as data transfer and data viewing, which helps to construct a new communication network for many vehicles and to manage and supervise the traffic.

2. OBD Technology and ELM327

All Electronic control unit (ECU) which is responsible for engine management and controls, continuously calculates the parameters by checking the engine operating conditions, evaluates the data from sensors, is a very important part as a vehicle's brain in automotive industry. Electronic control unit that enables coordinated operation between vehicle's electronic and mechanical parts, uses CAN (Controller Area Network), LIN (Local Interconnected Network), MOST (Media Oriented Systems Transport) and FlexRay serial bus as a communication technology. CAN bus is preferred preferably due to its preventing cable conflict as its cost. Output socket that provides connection with vehicle's network data and outside is standardized by OBD protocol. In the course of time OBD standard has advanced and variable data as error codes added by OBD I. Finally in 1996 OBD II standard was determined as a single connection for all vehicle manufacturers by SAE (Society of Automotive Engineering) [21, 25, 6].

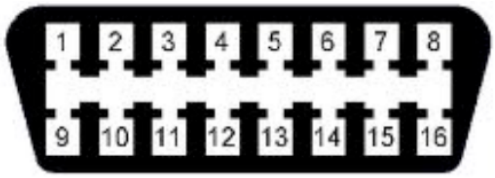
The diagnostic connector with OBD II standard providing information about situation of the engine and vehicle equipment specifies the type of connectors, the message format and electrical signalling protocols. J1962 connector with 16-Pin is a standard used in all vehicles. Connection of OBD socket have supported five different protocols to be used in various vehicle models [26].

Table 1. OBD II Communication Signal Protocols

Communication Protocols
SAE-J1850 pulse width modulation
SAE-J1850 Variable pulse width modulation
ISO-14230 keyword protocol 2000.
ISO-15765 Controller Area Network (CAN)
ISO-9141-2 protocol

Each vehicle uses one of the protocols in Table 1. For example, Chrysler ISO 9141, General Motor SAE J1850 VPW and Ford SAE J1850 PWM. OBD II connector input terminals are given in Table 2.

Table 2. 16-pin (2x8) SAE J1962 OBD Socket



PIN	Tanımlama	PIN	Tanımlama
1	Vendor Option	9	Vendor Option
2	J1850 Bus +	10	J 1850 Bus -
3	Vendor Option	11	Vendor Option
4	Chasis Ground	12	Vendor Option
5	Signal Ground	13	Vendor Option
6	CAN (J-2234) High	14	CAN (J-2234) Low
7	ISO 9141-2 K-Line	15	ISO 9141-2 K-Line
8	Vendor Option	16	Battery Power

In order to convert and make meaningful the data from a vehicle's parts like engine, chassis and electronic parts, various OBD devices are manufactured compatible with OBD II socket terminal. After the appropriate OBD device is connected on the vehicle, it provides communication with the vehicle's specified data bus. For each part out of which data has been obtained, Diagnostic Trouble Codes-DTC is used in the process of fault diagnosis and correction.

2.1. ELM327 OBD Diagnostic Device

OBD diagnostic device provides monitoring of real-time vehicle data and of fault codes over the CAN bus. ELM327 OBD scan tool developed for this purpose performs as a bridge between CAN bus and OBD ports. There are CAN data converter, and OBD connector in the diagnostic device [14, 15]. A standard datasheet has been created for ELM327 diagnostic device. ELM327 diagnostic devices have the onboard memory and have the ability to automaticaly connect to

the OBD protocols. ELM327 AT command line interface is used for electronic control unit [27].

ELM327 uses On-board Diagnostic Parameter ID (OBD PID) standardized codes to communicate with the vehicle over Hyperterminal. OBD commands dataset not only consists of default commands but also have 3 bytes long header, 1 byte long checksum and message format as well. Maximum data length is 7 bytes long. After being sent to Electronic Control Unit commands are compared using address selector via data bus and replied back. Necessary protocol is chosen. Test modes and PID code list specific to SAE 1979 standard and 15031-5 standard are specified by vehicle manufacturers. By choosing Default PID codes, for example MOD 01 PID 00 code Access to all vehicles may be accomplished. But limited access will be granted. Vehicles may not support all values of PID codes in all modes. ELM327 uses AT prefix to transmit PID codes. ELM327 provides code transformation process in communication with ECU and data is received from the vehicle as hexadecimal values.

ELM327 data are expressed as engine cycle, calculated load value, antifreeze temperature, fuel system status, vehicle speed, short-distance fuel consumption, long-distance fuel consumption, intake manifold pressure, timing advance, intake air temperature, air flow rate, oxygen sensor voltage, and the fuel pressure. Identifying information of the vehicle such as brand, model, weight and etc. can be reached thanks to vehicle VIN number which is received from the ELM327 device. ELM327 device supports OBD-II protocols. There are versions of it which are wi-fi, bluetooth and USB connectivity features. Moreover, it can be different dimensions. ELM327 OBD-II softwares receive information from the vehicle computer and allows them to be displayed on your computer and mobile devices.

ELM327 Bluetooth Device

ELM327 Wi-Fi Device

Figure 1. Wireless ELM327 Devices

3. Communication with Mobile Devices

Wireless data communication on mobile devices is made more effective by developing technology. Smart phones using 3G, wi-fi, bluetooth technology located in the traffic management and control applications, and provide the prevention of possible accidents. Data sharing, vehicle safety, driving safety, road safety and traffic control can be provided with internet capability of smart phones. The connection between ELM327 diagnostic device and mobile devices can be supplied via Wi-Fi or Bluetooth. Lots of traffic applications for Android and iOS smart phone operating system has been developed. Data can be displayed with the

developed software on a smart phone connected to the diagnostic device is used to provide communication Electronic Control Unit ELM327.

Standard software for communication between ELM327 and mobile devices: Android-based device software ELM327; Torque was developed to be compatible with the most comprehensive software ELM327 employees. ELM327 iOS-based device software; dashcommand, iobd2, mobilsec OBD, md4myc is, logworks, Rev, roaders, EOBD.

Thanks to the developed mobile software, on a line that is moving the vehicle, the driver of the vehicle information access can be achieved easily with ELM327 device. The data can be transmitted to a remote server via 3G Smart phone with an Internet connection. The accident vehicle location information can be shared with GPS capabilities of smart phones. Thus, a database which will be contributed to the Traffic Management and Control System. ELM327 data from the device VIN is the defining feature about the car sharing the number of vehicles through the remote server in case of congestion, the system which warns drivers about road traffic information could be improved.

4. Conclusion

Warning of the driver against the possible accidents is important for ensuring of the traffic safety by using OBD diagnostic tool upon receipt of data from the vehicle's CAN Bus Network. In this study, a comprehensive literature research carried out and monitoring of vehicle data with the mobile technology mentioned and using of ELM327 OBD diagnostic device explained for a quick solution to driver in highway traffic. Software used in a large number of smart phone application that performs the transfer quickly to the drive of vehicle data are analysed. The development of smart applications for highways will create a solution to the traffic information systems, vehicle tracking applications and traffic congestion problems.

Thanks to smart phone features, vehicle data are displayed and transmitted to a remote server with the support of the internet which is to increase the sharing of information. Thereby, it will contribute to the driver information systems by ensuring communication both inter-vehicle and between the vehicle and environment contact. Also internal sensors located in mobile devices such as GPS provide advantage for intelligent transportation systems on the roads.

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