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INTERACTIVE AUGMENTED SERVICE SYSTEM FOR ISOLATED SMART CARS

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ABSTRACT

Servicing of cars which are isolated from the towns is found to be a painful problem and time elapsed in getting minor malfunctions service is found to be enormous and intolerable. Hence it is proposed to design a mechanism to assist the driving personnel in servicing their vehicle. In this technology, based on the signals received from the Self-Diagnosing System (SDS) the Interactive Visual Response System (IVRS) will sort out the exact remedial training video to rectify the problem from the remote server provided by the vehicle manufacturer which is equipped with service training videos of real world problems and with proper identification system and the same will be displayed on left eye side of the goggle, worn by the driving personnel. The personnel can perform the service work as per the video instructions through right eye side of the goggle which is a clear glass and exposed to the real world. Electronic Engine Management System (EEMS) provided in the vehicle has a satellite and Bluetooth Video Streaming Technology (BVST) for effective communications. Hope this technology will help the driving personnel in troubleshooting their vehicles and would increase their morale by safer and timely journey.

Keywords: *Bluetooth Video Streaming Technology, Electronic Engine Management system, Interactive Visual Response System and Self Diagnosing System.*

I. INTRODUCTION

While driving in the highways, we can see several cars parked in the service lane or roadside for servicing. Even though todays' technologies in communication brought the world in our hand, we find it very difficult to service the cars immediately. When the cars are locked up in the remote regions such as hill stations, country sides, it becomes more tedious to rectify this problem of servicing the cars. The time between the intimation about the repair of cars to the service center and arrival of service personal to that location is intolerable.

Although all the villages are having good service centers provided with latest equipment and experienced service personal, the difficulty arises due to the recent technologies developed in the automotive area. Since most controls and components of latest cars are electronically controlled, service persons find it very difficult to service them [1]. Even though the problem in the car is very small, without having any background idea about the todays' electronic components, they are unable to solve the problem. Especially in the case of self-driving, the people find it very difficult to face these kinds of situations.

Hence it is intended to propose a solution that can meet the issues related to the above discussed problem at a fundamental level.

II. INVENTIVENESS FOR THIS WORK AND OVERVIEW OF THIS TECHNOLOGY

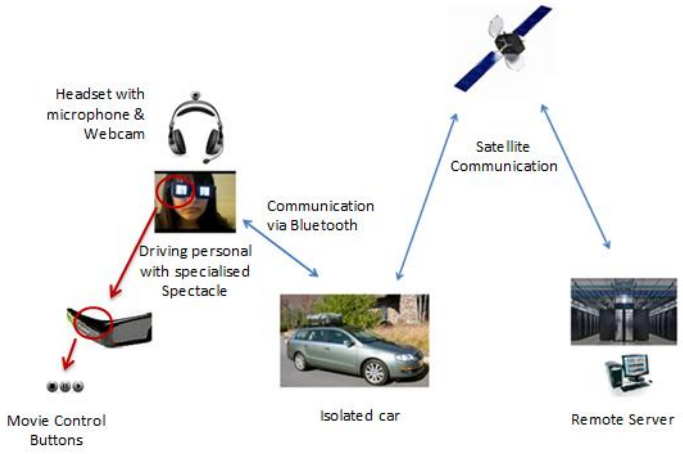
An easy way to comply with the conference paper forThe basic idea is conceptualised from the movie True Lies which is co-written and directed by James Cameron and Arnold Schwarzenegger playing the major role released during 1994. In this movie, the agent is using a goggle which telecasts the video recorded lively by a handy-cam held in his hand. He used this technology to observe the actual scenario behind him. Because of the developments happening in the field of display techniques, more companies are involving in the manufacturing of Smart goggles.

Vuzix Smart Glasses make model M100 is a hands free display and communications system. A virtual display with integrated camera and a transmission engine is more powerful for having connections and works along with the Interactive Response system for different applications. The camera/display functionality of this kind of glass leads to the development of more advanced features like augmented reality applications. The glasses include an integrated head tracker and GPS for spacial and positional awareness and an integrated camera enables video recording and still image capture. This interactive tracking and integrated camera combined technology helps us to the development of virtual reality [2].

The Wrap make model 1200 widescreen video eyewear connects to virtually any audio video device in either 2D or 3D environment. It provides a wide screen video display about 16:9 widescreen experience equivalent to a 75-inch virtual screen viewed from ten feet (3 m) which provides good 2D or 3D video quality for watching videos. Focus, eye- separation and viewing angle adjustments and compatibility make this glass more flexible and favorite one [3]. The development in the field of manufacturing theses kind of glasses further motivates the adaptation of this technology in the smart car service systems.

Another important factor that paves the foundation for the development of this work is the expertise services render by BMW to its customers [4].

Fig 1. Working modes of this technology



The recent BMW cars are provided with condition based service sensors which monitors the engine components and if there is a malfunction in the vehicle the service-related data are automatically relayed to the service center. The remedial action is purely dependent on the accuracy of the data relayed. The service people at the remote centers will analyze the precisely received data which provides the immediate information and

maximum reassurance about the vehicle. Based on the data, the service specialists can describe the condition of vehicle precisely over the phone and provide a suitable solution for appropriate action.

In this regard, when it was intended to formulate a problem model, it was found that these problems can be easily solved up to some extent when the problem is very small, by means of transferring the necessary technical solution support to the needy people.

Almost in all automotive engineering sections, the newly recruited people are given video based step-by-step training. The videos are produced for a particular model of the manufacturer. These videos provide complete information about the dismantling, inspection, servicing, and assembling of all components involved in the assembly. Above all, these videos are added with self-narrated explanations. By imparting the necessary videos to the people in need, the above discussed problems can be solved easily.

Since all recent cars are equipped with Electronic Engine Management System (EEMS), on-line self-diagnosing the performance of cars becomes easier. The diagnosed problem can be sent to the central host server which is located at one of the hubs of the manufacturers or service providers through satellite communication.

Using interactive visual response system (IVRS), by the way of sorting, the exact video solution for the corresponding problem can be identified in the server by using any of the available search algorithms. When the identification process becomes very complicated, a bi-directional communication between the server and the user can be also made using the interactive visual response system (IVRS).

During the purchase of the car itself, a specially designed spectacle will be supplied to the user along with the tool kit. A light emitting diode (LED) monitor is mounted in the left hand side of the spectacle while the right hand side of the spectacle is made of ordinary transparent glass. A headset with microphone along with the spectacle makes the working environment more user-friendly. Video control buttons like play, pause, repeat, stop and necessary audio control buttons are also mounted on the spectacle frame. The selected video from the server is transmitted and allowed to telecast on the LED monitor on the spectacle.

By visualization, the driving personal can get a clear idea about the servicing techniques for the current problem, can clear his doubts by using the available option buttons and can perform the necessary actions for the service of cars.

A webcam is also attached with the spectacles to display the real time scenario to the customer care personal who is sitting remotely in the server station. When the problem is very complicated or can't be understood by the service personal, they can easily receive the informations about the problem occurred in the vehicle. The webcam is equipped with an automated illumination system to capture good videos from the remote location.

It may be suggested that with this technique, the driving personal can do any kind of service with the available facilities without considering their topography. It may be further justified that this technique may result in the safe, timely, happy and satisfied journey for all the people.

III. INTERACTIVE VISUAL RESPONSE SYSTEM (IVRS) AND ELECTRONIC ENGINE MANAGEMENT SYSTEM (EEMS)

The Interactive Visual Response System (IVRS) is a very useful technology that automates the interactions when the identification of the malfunction happened in the vehicle becomes more complicated. A bi-directional communication system between the user and the server makes the system more meaningful and provides an effective way of communication.

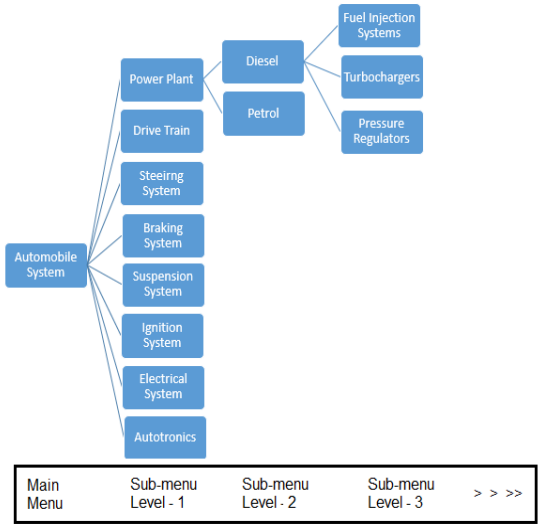


Fig 2. Decoding & Sorting Using IVRS

Figure 2 demonstrates a sorting process happening in the remote server [5]. The same can be used for the driving personal for identifying the remedial videos by themselves using this IVRS technology and if required with the help of the technical service experts sitting in the server locations.

The analog and discrete signals required by the Engine Control Unit (ECU) can be generated by a data acquisition card which is controlled by the ECU.

The EEMS converts driving requirements into a corresponding actuating signals. The complexity of the system progresses as the number of engine sub-systems increases and the increase in the number of variables to be controlled to have an optimal drivability. The required accuracy and adaptability of the systems are essential to ensure the better performance of the entire system. EEMS has a predominant role in identifying the malfunctions in the systems.

The EEMS is organized to perform different functions such that each function manages a specific engine activity to accomplish some definite target. The entire operations are monitored and controlled by a micro controlled device which defines the engine states and manages the transition between the states.

The EEMS is also very much useful to provide acceptable drivability under all operating conditions. The ideal speed control, stalls, hesitations, or any other objectionable roughness should be avoided during running conditions which are measureable.

The actuating signals and the feedback signals received form the sensors are given unique fault code using a coding system. A closed loop system is used to compare these two types of signals and to generate the rectifying signals under deviated conditions. The history of fault codes are stored in a memory unit and can be retrieved when the demand arises.

The EEMS working principle can be easily understood by the Figure 3 given [6].

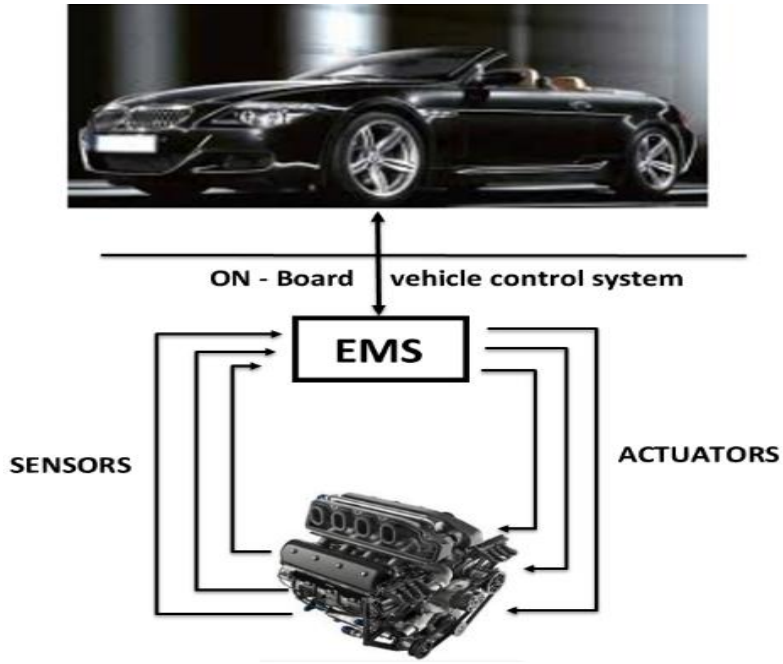


Fig 3. Layout of an EMS

The major components of the EMS include:

i. Sensors for the detection of the engine operating

ii. Electronic Engine Management System which converts the sensors signals into corresponding codes and issues the operating instructions to the actuators according to the KMS.

iii. Actuators which initiates the system components as the instructions received from the EMS.

The malfunctions occurred in the vehicle can be diagnosed, controlled and monitored by On-Board Diagnostic system [7] [8].

IV. CAR SELF DIAGNOSIS SYSTEM WITH BLUETOOTH VIDEO TRANSMISSION TECHNIQUE

The Self Diagnosis System (SDS) is designed to control all aspect of vehicle such as engine management, transmission, suspension, accident prevention, vehicle tracking, electrical and electronic systems [9]. The complexity of the connections are made easier using multiplex wiring system for networking. The fibre optic cables (FOC) are used for the data transmission between all the units with the central SDS. The added advantage of using FOC is that the system becomes totally resistant to electromagnetic interference. Remote center diagnosis can also be made possible by networking [10] [11] [12] [13].

The tools like oscilloscopes, engine analyzers, multimeters and digital measuring instruments are used for diagnosing. The specially designed hardware circuits flashed with specific programs are provided to take care for the self-diagnosing. The hardware signal ranges are calibrated with the operating values of sensors and actuators. The violations from the normal signals are identified and are displayed as standard fault codes that can be easily interpreted by the SDS [7] [8]. A sample Engine Management System provided with the PIC32 type microcontroller is shown in the figure 4.

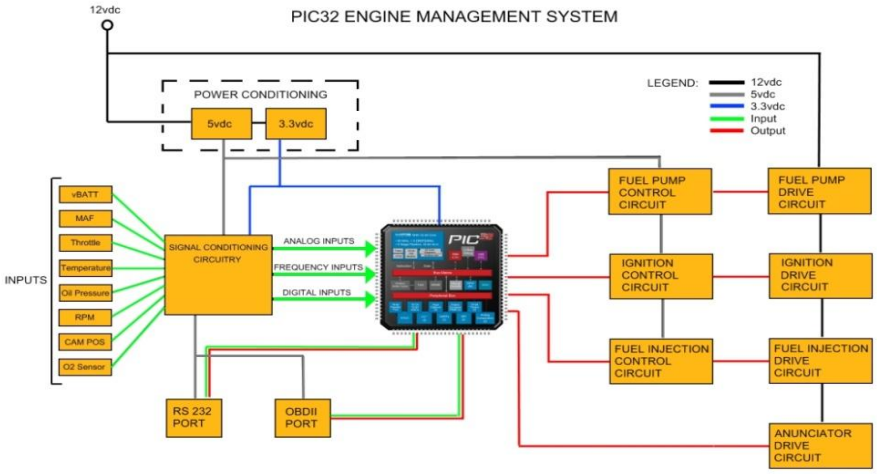


Fig 4. PIC32 microcontroller based Engine Management System

The fault codes diagnosed by the cables are sent to the SDS server and then the memory of the cables are erased by earthing them for ten minutes continuously. The SDS will automatically decode the fault code for further diagnosis. In some cases, the data acquired by the diagnosis wires are sufficient, the SDS will automatically substitute some pre-programmed default values to ensure convergence and safety.

The intelligence of the engine management system is ever expanding and the information provided by vehicle sensors is of a higher quality and on a more timely basis. This allows the engine management system to have a self-diagnosis capacity in order to monitor vehicle status. The engine management system monitors the Fuel System, the Exhaust Gas Recirculation system, the Purge System, the catalyst, misfire, and Oxygen Sensor [14]. A properly operating Oxygen Sensor has become one the most important components for the engine management system, in terms of emissions compliance.

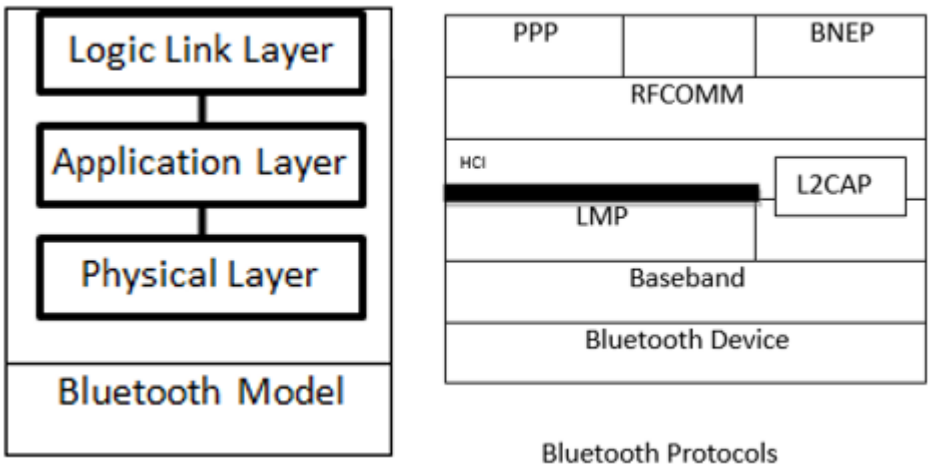


Fig 5. Bluetooth Architecture

Bluetooth is a wireless, low cost and less power consuming data transmission technology especially used to transmit data between devices that may be connected in a pattern as ground-ground or ground-mobile or mobile-mobile. When the connection is made within short range (approximately 4 meters), the data transmission is

found to be very effective. Even though it seems to be widely used in many devices, unfortunately there are many obstructions to use this technology in the real world scenario. The major barriers restricting the implementation of video streaming are bandwidth, error rate and distance.

The above said difficulties can be resolved by focusing on the development of intermediate protocols, quality of service control and compression techniques, etc. [15].

Bluetooth supports connections such as peer to peer (one to one), piconet (one to many i.e., master to nodes) and scatternet (inter-piconet) for video transmission and streaming.

The outer most layer Logic Link layer offers two types of connectivity such as Synchronous Connection Oriented Link that meant to be master for peer to peer connections with the speed of 64kbps and Asynchronous Connection-Less Link which is meant for slave in piconet connections with the speed of 732kbps. The maximum uplink speed is 128kbps and maximum download speed is 732kbps [16].

The baseband acts as the physical layer and performs the functions such as error correction, packet handling and security. The Link Manager Protocol (LMP) executes the data encryption and link control. L2CAP stands for Logical Link and Control Adaptation.

Protocol establishes two types of services such as Connection Oriented and Connection-Less links to upper layer protocols. The process of segmentation and reassembling of the packets are taken care by the L2CAP itself. The combination of LMP and L2CAP performs as the application layer. The Host Controller Interface (HCI) makes the process of hardware interfacing easier and effective. The HCI is fully responsible for the effective data transmission.

4.1 Rfcomm : This Radio Frequency Communication protocol is the convenient transport protocol for L2CAP model, Many Bluetooth applications use RFCOMM because of its widespread support and publicly available interface on most operating systems. It enables serial connection via RS-232 port. This serial connection enables Bluetooth connection between two different systems with same application.

4.2 Hci : Video is directly packetized for maximum utility of bandwidth leads to minimum numbers of operations to lower layer. Packet size depends on the buffer. No segmentation and reassembling. Cannot be used without L2CAP [17].

4.3 L2cap: upper layer retransmission to selected retransmission through Internet Protocols (IP). It reduces the complexity level. It avoids most of the modifications in the existing applications. It is safer than HCI, even though its overhead size is bigger when compared to HCI.

The three applications of L2CAP namely Audio Video Distribution Transport protocol (AVDTP), Audio Video Control Transport Protocol (AVCTP) and Generic Audio / Video Distribution Protocol (GAVDP) are based on the Real Time Protocols (RTP). Among the three specifications, AVDTP is suggested to transmit data through L2CAP and is mostly used for point to point connections. It also provides streaming discovery, configuration, establishment and transfer control.

4.4 IP: IP relay on TCP / IP. Through this protocol, the RTP can be used without any modifications. It can also provide a way for convenient transmission than L2CAP even though its pocket size is larger than L2CAP. The two ways of streaming in IP are LAP or BNEP.

The reasons such as time varying features and interference make video streaming on Bluetooth more challenging.

4.5 Video Compression: The aim of video compression is to remove redundant information from a digitized video sequence. The techniques including in the video compression are MPEG-4 and H.263.MPEG-4 is ideally suited to low bandwidth applications, exactly matching the requirements for video over a wireless Bluetooth network [18].

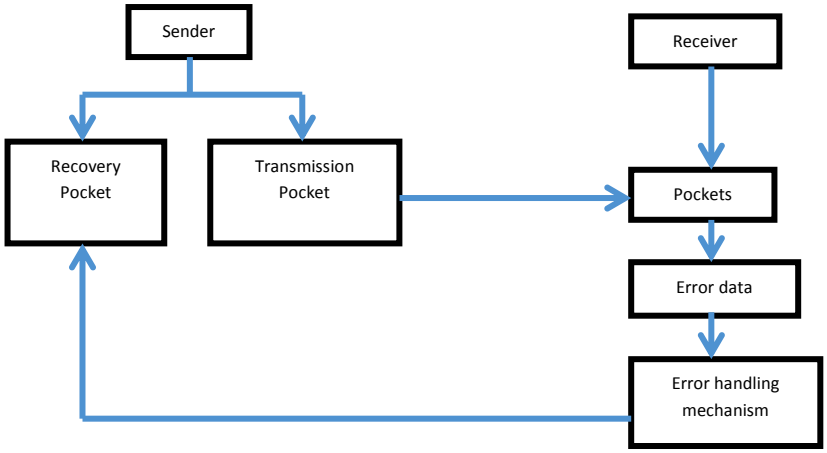


Fig 6. Bluetooth Data Transmission System

Zig Bee Technology: Zig Bee a standards-based wireless technology cater to the needs our requirements. This technology is easy to implement and uses the 2.4 GHz radio frequency to deliver a variety of reliable and easy-to-use standards anywhere in the world. This technology has a greater degree of freedom and flexibility over its control systems. The simple device-to-device topology provides easy development and testing, resulting in featuring a simple, robust and low-cost communication network for two-way wireless connectivity.

As a conclusion Bluetooth is an exciting technology for mobile devices and serves the purpose of streaming video in ad hoc network environments. Among multiple Bluetooth layers, it is very important to choose a proper intermediate protocol for packetizing and segmenting media streams. We can provide an optimal cross-layer QoS strategy for enhancing the robustness and efficiency of video transmission over Bluetooth links.

Video compression is critical for video streaming over Bluetooth due to the time-varying link, limited bandwidth and resource constraint devices [19]. We could exploit scalable encoding mechanisms to provide more flexibility in meeting different QoS requirement and changing bandwidth [20].

V. AMALGAMATION OF THE SYSTEM

This system integrates the recent developments happening in all the areas of engineering and capable of producing very good customer satisfaction. The stages involved in the process are broadly classified as below.

In the Identification phase the SDS identifies the malfunctions happened in the system. In the Classification phase, the EEMS generates a corresponding code using SDS and the code is transmitted to the central host server of the manufacturer or service provider through satellite communication.

During the Interaction phase, the communication between the driving personal with the technical service experts sitting in the service centers and vice versa is made possible. According to the code received, the exact video solution for corresponding problem is identified in the server in the Sorting phase.

During the Decision Making phase, the identified video is checked and verified one again for its suitability of that requirement. In the Display phase, the suitable video identified is transmitted to the EEMS through satellite communication and telecasted to the needy using Bluetooth video streaming technology. If the suitable video is not found in the server, the same may be informed to the developers for updating the server by adding related remedial videos in the Update phase.

The above flow chart explains the working of the designed and developed system. In some cases, the specially prepared spectacles can be replaced by means of a LED monitor mounted on an overhanging flexible frame which can be tilted to any position by manually and easily outside the vehicle.

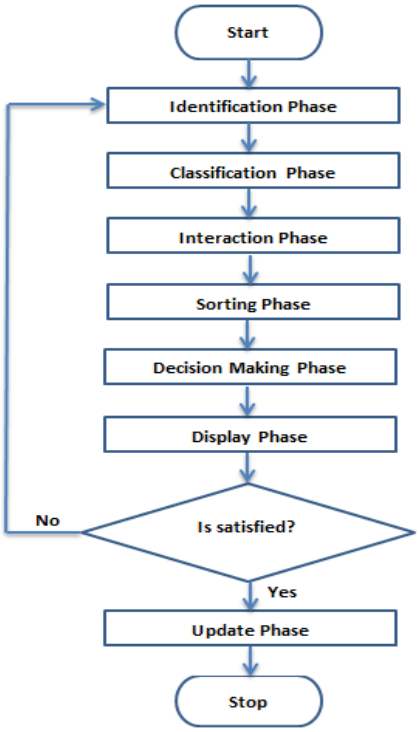


Fig 7. Flowchart for the Integration of the Technology

VI. CONCLUSION

The EEMS and SDS are making the vehicles very environment friendly as they were capable of controlling all aspects of vehicle such as engine management, transmission, accident prevention, vehicle tracking, etc. Since the fibre optic cables are used for data transmission system between all the units of the system with central SDS, the fault identification, fault code generation, sorting of videos in the server, and the telecast of remedial video will be done more effectively and efficiently within less time. Hope this technology will help the driving personnel in troubleshooting of their vehicles by their own with the guidance from remote server and will also increase their morale. This will result in the safer and timely journey for the occupants makes the journey pleasant and comfortable. Further a technology is also developed by integrating the available recent technologies in the field of automobile, electronics and information technology and leads to the foundation of a new way of customer satisfaction. The efficiency of data transmission and data losses during raining seasons may be considered for the future work. The effect of displays very close to the retina can be also considered for the future development.

REFERENCES

[1] Fang Tu, Jianhui Luo, et al, *"Intelligent model-based diagnostics for vehicle health management"*, Proceedings of the SPIE – The International Society for Optical Engineering, *pp 13-26*, April 2003, Orlando, USA

[2] http://www.vuzix.com/developer/

[3] http://www.vuzix.com/UKSITE/consumer/products_wrap_vr1200.html Tavel, P. 2007 Modeling and Simulation Design. AK Peters Ltd.

[4] http://www.bmw.com/com/en/owners/service/care/workshop_offers.html

[5] Laci Jalics and Song You, *"Adaptive Threshold Based Diagnostics for Steer-by-Wire systems", DRLR-0244*, May 2003

[6] Porsche 914 Factory Workshop Manual *Vol.2*, "*Fuel System",* pp 0.1 to 1/8]

[7] http://www.obdii.com

[8] http://www.autotap.com/

[9] Fang Kunli, Fang Xiaofen, Xu Jianliang and Yang Fan, *" Knowlegde-based Auto Repair Diagnosis System and Application"*, 2nd International Conference on Advances in Computer Science and Engineering, CSE 2013

[10] Michael Suman et al., *"Vehicle communication and remote control system", US patent Number 06028537*, Feruary 2000

[11] Ulrich Hiermann, "*A remote diagnostic for motor vehicles*", Europe patent publication *No.01069422/EP A1*, January 2001

[12] Rodney Allen JR, William D. Norwood, "Vehicle *service and maintenance tracking system"*, US patent publication number *20020195503*, December 2002

[13] Peter Dix, *"Remote vehicle diangnostic system",* US patent publication number *20030095038*, May 2003

[14] Laci Jalics and Song You, *"Hierarchical Component-based Fault Diagnostics for By-Wire systems"*, SAE paper # *2004-01-0285*, March 2004

[15] Chia-Yuan Huang, Shauo-Gang Miaou, et al, *"Quality Degradation and Improvement of H.263 Video Transmitted in Bluetooth Packets under the Interference of Wireless LAN",* IEEE GlobeCom 2002, Taipei, China, 2002

[16] M. Cesana, M. Gerla, and R. Kapoor*,"Link Layer Support for Streaming MPEG Video over Wireless Links"*, 2003 International Conference on Computer Communica- tions and Networks (ICCCN 2003), 2003

[17] M. Fleury, M. Ghanbari, E. Jammeh and R. Razavi, "An *Efficient Packetization Scheme for Bluetooth Video Transmission"*, Electronic Letters, *vol. 42, no. 20, pp. 1143-1145*, 2006

[18] Chong Hooi Chia and M. Salim Beg, *"MPEG-4 video transmission over Bluetooth links"*, Proc. IEEE International Conf. on Personal Wireless Communications, New Delhi, 15- 18 Dec 2002

[19] Mario Gerla, Matteo Cesana, and Rohit Kapoor*, "Link Layer Support for Streaming MPEG Video over Wireless Links",* 2003 International Conference on Computer Communications and Networks (ICCCN 2003), 2003

[20] W. Xiaohang*," Video Streaming over Bluetooth: A Survey",* URL: http://www.comp.nus.edu.sg/ cs5248/0304S1/surveys /wang-bluetooth.pdf

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