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In-Cabin Sensing/Monitoring, Controlling of Automotives Using OBC

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Abstract- Today vehicles are increasingly equipped with smarter electronics to improve both safety and comfort. In this work, an On- Board Diagnostic (OBD) & Monitoring & System using On-Board Computer (OBC) has been developed. Multiple sensors are used to monitor Engine Parameters, Emission Levels, Smoke, Temperature, Fluid Levels and Safety Conditions of the vehicle. The OBC collects this information in real time and performs actions such as Raising Alarms, Controlling Cooling Systems, Sending Diagnostic Alerts through GSM, and preventing failures. proposed system mainly covers Engine Temperature, Emission Monitoring, Fuel Flow, Smoke and Fire Detection, Coolant and Fluid Levels, Battery Monitoring, Tyre Pressure, Cabin Temperature and Accident Alerts through Global System for Mobile Communication (GSM). Experimental Tests Confirm that the system operates reliably with quick response time. This work demonstrates that OBC- based integrated solutions can play a key role in enhancing road safety and passenger security in modern automobiles.

Indexed Terms- Automotives Safety, On-Board Computer, Emission Monitoring, Engine Diagnostic, GSM Alerts, Tyre Pressure Monitoring, Fire and Smoke Detection.

I. INTRODUCTION

With the rising number of vehicles on roads, ensuring driver and passenger safety has become a major challenge. Reports from the World Health Organization (WHO) highlight that nearly 1.3 million people lose their lives every year due to road traffic accidents, while millions more suffer from injuries. In India, statistics from the Ministry of Road Transport and Highways show that a majority of crashes occur because of careless driving, Engine Overheating, Emission Faults, Sudden Fire, Brake or Fluid Failure and Loss of Tyre Grip. Traditional vehicles depend largely on passive safety features such as Air bags, Seatbelts and all of these mechanisms reduce the damage after an accident but do not actively prevent all the accidents.

In contrast, active safety systems monitor the situation events before they occur. Examples of such systems include Anti-Lock Braking System (ABS), Lane-Keeping Assistance, and Stability Control. However, most of these are either available only in Premium Vehicles or focus on external driving conditions, not on the driver and cabin environment.

In recent years, improvements in sensor technology and embedded controllers have made it possible to design an intelligent Vehicle Monitoring Systems by using an On-Board Computer. Multiple inputs can be processed simultaneously, and coordinated actions can be taken quickly. Unlike a single-purpose microcontroller, the OBC allows a modular and scalable approach that can handle different functions together. The condition of the Engine, Fluids, Emissions and Electrical Systems in one of the most important factors in maintaining safe vehicle operation.

Excess Engine Temperature, Low Coolant Levels, Emission Irregularities, Oil Leakage, Battery Faults, Tyre Pressure Changes, and Smoke Hazards can increase the probability of Breakdowns & accidents. Which is danger for the drivers and passengers who uses the Vehicles Pedestrians are also being affected by this. Continuous monitoring of these parameters is has increasingly turned toward the integration of multiple sensors and monitoring devices within the vehicle cabin. By collecting real-time data on Engine Temperature, Exhaust Emission, Fuel Flow, Coolant, Tyre Pressure and Smoke Hazards these systems are able to provide early warnings or even intervene directly to prevent accidents. However, many of the existing systems are standalone solutions that perform one function at a time, which often leads to higher cost, scalability, and less effective responses during emergencies.

The On-Board Computer (OBC) offers a practical solution to this problem. As a central controller, it can process data from several sensors at once, apply decision-making algorithms, and activate the required control actions with minimal delay. This integration not only reduces the need for multiple independent modules but also ensures faster communication between sensors and actuators. The aim of this project is to design and implement an OBC based system that combines Engine Monitoring, Exhaust Gas Sensing, Fuel & Oil Level Verification, Coolant & Brake Fluid Monitoring, Tyre Pressure Checking, Battery Health, Cabin Temperature, Smoke/Fire Detection, GSM – based Accident Alerting into a single Framework.

II. LITERATURE REVIEW

The development of intelligent automotives systems has gained significant attention in recent years as researchers strive to enhance vehicle safety, comfort and performance through integrated monitoring technologies. Esfahani et al. presented a hierarchical control design of modular integrated OBC for dual motor electric vehicles. Their research established how modularity and distributed control improve fault tolerance and system scalability, laying a foundation for centralized vehicle monitoring frameworks [1]. Similarly, Kumar and Bansal proposed a GSM- based communication model for transmitting emergency alerts from vehicles proving that GSM can reliably support real-time automotive communication in mobile environment [2].

Mazidi et al. explained the design and interfacing of PIC microcontrollers in embedded applications. Their study emphasized efficient synchronization between hardware and software, making microcontrollers highly suitable for In – Cabin sensing and automotive control systems [14]. Meanwhile, Hsu and Chen demonstrated a low – cost emission monitoring system that detects pollutant concentration in exhaust gases using integrated gas sensors, ensuring that vehicles operate within environmental scandals [6]. Sharma and Patel developed an alcohol detection and ignition control system proving that integrated sensors can prevent accidents caused by drunk driving. The system successfully blocked engine ignition when alcohol concentration exceeded the safety threshold, showcasing the importance of real-time sensor- based prevention mechanisms [3]. Narayan et al. explored the use of MEMS – based devices offer compactness, precision and high sensitivity for both engine and cabin – level safety monitoring [10].

Verma et al. contribution an in-cabin smoke and fire detection unit that automatically triggers alerts in case of hazardous fumes or overheating, thereby improving passenger safety. Their research emphasized the necessity of environmental sensing as a crucial component of smart automotive systems [7]. Misra and Saha further supported this by developing a microcontroller – base monitoring unit for engine temperature and fuel level, demonstrating that low – cost embedded hardware can efficiently manage multiple sensing function simultaneously [12]

Communication between sensors and controllers has also been studied extensively. Banerjee and Thomas highlighted the reliability of RS – 232 and GSM integration in data transmission systems, showing that proper interfacing protocols reduce delays and prevent data losses during vehicle – to – base communication [13]. In another work, Rathore et al. implemented combined GSM & GPS communication framework to provide accurate accident alerts and location tracking, proving its effectiveness in reducing emergency response times [5].

Tripathi et al. introduced an internet of things (IOT) – based system for real – time vehicle health monitoring. Their work utilized multiple sensors to collect temperature, vibration and emission data, which were transmitted to clouds servers for predicting analysis and maintenance scheduling. This approach helped reduced vehicle down time and improved operational safety [11].

Wang et al. explored real – time monitoring and fault diagnosis of automotive sensors using microcontrollers, demonstrating that microcontroller – based frameworks can efficiently handle multiple sensing signals and detect faults promptly

III. PROPOSED METHODOLOGY

The proposed methodology is centered on the design and implementation of an in – cabin sensing, monitoring and controlling system using an on – board computer (OBC) that monitors, processes and controls vehicle parameters in real time. The complete setup is designed to ensure safety, efficiency, and reliability through continuous monitoring of both engine and cabin conditions. The design has been divided into several functional blocks for better understanding, namely the Sensing Unit, Signal Conditioning, Control Unit, Communication Unit, Cooling System and Feedback Operation.

Sensing Unit

The sensing unit forms the backbone of the system. All the critical components of the vehicle are monitored with the help of dedicated sensors.

1. Engine Temperature Sensor (NTC Thermistor):

An NTC thermistor is used for monitoring engine temperature. Its resistance decreases with an increase in temperature, allowing it to provide precise measurement over a wide range. Continuous monitoring ensures that the engine does not reach overheating conditions, which could lead to mechanical failure.

2. Exhaust Temperature Sensor (Orifice Sensor):

This sensor detects the variation in exhaust gas temperature. A sudden rise in exhaust temperature may indicate improper combustion, blocked air intake, or engine misfiring. Monitoring this parameter not only improves fuel efficiency but also reduces harmful emissions.

3. Emission Monitoring Sensor:

The emission sensor is deployed to measure pollutants in the exhaust gases. This information is crucial to ensure that the vehicle operates within environmental norms and compiles with emission regulations. The sensor continuously monitors harmful gases such as carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (Nox), which are the major contributions to air pollutions. By detecting abnormal concentrations of these such as incomplete combustion, faulty injectors, or air – fuel imbalance at an early stage. The readings are processed by the OBC, which compares them against present emission limits. If the values exceed the threshold, an alert is generated for the driver, and the data is logged for further analysis during servicing. This ensures that the vehicle remains both environmentally complaint & mechanically efficient.

4. Fluid Level Sensor

Multiple fluid level sensors are employed for monitoring engine oil, brake fluid and coolant levels. Maintaining correct levels of these fluids ensures the safety of the braking system, efficient lubrication of engine parts, and prevention of overheating through the cooling mechanism.

5. Fuel Flow Sensor

Fuel consumption is monitored by a flow sensor. Abnormalities in the readings can indicate leakage, inefficiency in fuel combustion, or clogging in the fuel pipeline. Monitoring this parameter helps in maintaining optimum fuel economy.

6. Battery Voltage Sensor

Battery voltage monitoring ensures that the electrical systems of the vehicle operate with safe limits. A sudden drop in voltage can disturb ignition, lighting, and other onboard systems. The OBC tracks the battery state continuously and provides early alerts if the voltage drops below the threshold value of the pre – defined constraints.

7. Tyre Pressure Sensor

Tyre pressure is a critical safety parameter. Under inflated tyres increase fuel consumption and risk of blowouts, while over – inflated tyres reduce grip. By continuously monitoring the tyre pressure, the OBC ensures safe driving conditions.

8. MEMS Sensor

The Micro – Electro – Mechanical Systems (MEMS) sensor detects tilt, inclination, and lateral movement of

the vehicle. This feature is partially important for monitoring rollover conditions and ensuring stability.
Together, these sensors provide comprehensive information about the health of vehicle & safety.

Signal Conditioning & Transmission

The raw signals from the sensors are not always in a format suitable for direct processing. Therefore, each sensor output is first passed through signal conditioning circuits, such as amplifiers and filters. The conditioned signals are then transmitted to the OBC through the MAX232 DRIVER IC, which converts the voltage levels into compatible RS-232 signals. This ensures accurate and reliable communication between the sensors and the OBC.

Control Unit (On – Board Computer)

The On – Board Computer serves as the central processing unit of the system. It performs the following tasks:

- Continuously collects data from all sensors
- Compares each sensor value with predefined safety thresholds.
- Executes control actions such as triggering alarms, regulating ignition, and activating the cooling system.
- Logs abnormal readings for later diagnostic use.

The OBC makes the system modular and scalable. Unlike traditional microcontrollers that handle only a single function, the OBC allows simultaneous monitoring of multiple parameters, making the system efficient and reliable.

Communication Unit

The communication block is responsible for external alerts. The OBC is interfaced with a GSM module that sends short message service alerts during emergencies. For example, if a fire is detected, if coolant levels are too low, or if the MEMS sensors indicate a rollover, an emergency message is automatically sent to pre – configured numbers such as the driver's guardian or a control room. This enables timely intervention and ensures passenger safety even when the driver is unable to respond.

Cooling System Control

The system also incorporates an automatic cooling mechanism. When the NTC thermistor or coolant level sensor detects overheating, the OBC activate the forced cooling fan. This prevents engine failure and improves overall vehicle reliability. Cooling is one of the most critical aspects of long – distance or high – load driving, and automatic control reduces the need for manual monitoring by the driver.

Closed – Loop Feedback Operation

The entire methodology follows a closed – loop system. The sensors continuously monitor different parameters and send data to the OBC. The OBC processes the data, applies control logic, and activates actuators or communication units. The resulting changes (e.g., reduction in temperature, restoration of pressure) are again sensed and reported back to the OBC. This feedback ensures uninterrupted monitoring and adjustment, making the system adaptive to varying conditions.

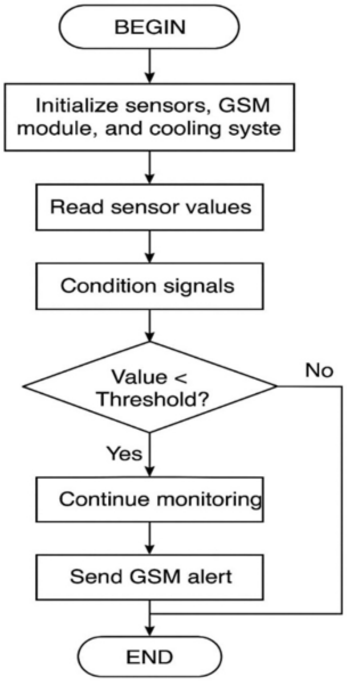

Fig. 1. Flowchart

Procedure Flow

Step 1: Initialize all sensors (Temperature, fuel flow, emission, fluid level, battery voltage, tyre pressure, MEMS, and smoke sensor).

Step 2: Start continuous data acquisition from each sensor (Temperature, Fuel flow, Fluid level, MEMS, GSM based alert messages, Gas detection) are used to alert the system give precaution & enhance safety

Step 3: For each sensor input, perform signal conditioning (Filter noise, convert analog to digital).

Step 4: Transmit conditioned signals to the On – Board Computer (OBC) through MAX232 interface.

Step 5: Compare each sensor value when its predefined safety threshold.

Step 6: If value < Threshold (Normal): Continue monitoring. Else if value >= Threshold (Abnormal condition):

- Activate alarm system.
- Control cooling system
- Send GSM alert to predefined contacts
- Log event data for diagnostics

Step 7: Update feedback loop – recheck parameters after control actions.

Step 8: Repeat steps 2 – 7 continuously until the system is powered off.

Logical Sequence

```
Start

Initialize sensors:
Temperature_ Sensor
Gas_ Sensor
MEMS_ Sensor
Fuel_ Sensor
Emission_ Sensor

Initialize microcontroller (PIC/ARM)
Initialize LCD / OBC display
Initialize serial communication (RS232)
While (vehicle_ power == ON):
        Read temperature_ value from Temperature_ Sensor
        Read gas_ level from Gas_ Sensor
        Read tilt_ value from MEMS_ Sensor
        Read fuel_ flow from Fuel_ Sensor
        Read emission_ level from Emission_ Sensor

//Signal Conditioning
Convert analog signals using ADC
Apply filters for noise reduction

//Condition Checks and Alerts
If (temperature_ value > Threshold_ Temp):
        Display "Warning: Engine Overheating"
        Activate buzzer
If (gas_ level > Safe_ Gas_ Limit):
Display "Warning: Gas Leakage Detected"
Activate alarm
        If (tilt_ value > Safe_ Angle):
                Display "Warning: High Emission Level"
        If (fuel_ flow < Minimum_ Flow_ Rate):
                Display "Check Fuel Supply"

        //Data Transmission
Send all sensor data to Onboard Computer via RS232
Display reading on LCD/OBC screen

Wait for 1 second
Repeat loop

End while
Stop
```

Mathematical derivation and calculation

Sensor calibration and calculations are based on standard equations for thermistor temperature conversion, flow rate estimation, and MEMS acceleration sensitivity [General Engineering Formula].

Parameter	Formula/Method	Example Calculation	Result

Temperature	Temp (°C) =(V/5) * 100	(3/5) * 100	60°C
Fuel Flow Rate	Flow = Frequency * Constant	100Hz * 0.2	20/min
Emission level	CO2=Absorption ratio *100	0.08 * 100	8%
Tilt Detection	(Vx – 1.65) / 0.3	(2.5 – 1.65) / 0.3	2.83 g

System Architecture

The proposed methodology can be represented by a block diagram in which the sensor layer (engine temp, exhaust, emission, fluids, fuel, battery, tyre, MEMS, smoke) forms the input, the OBC layer acts as the processing core, and the actuation and communication layer (alarms, ignition control, cooling system, GSM alerts) forms the output. The interaction between these layers ensures that safety actions are triggered automatically without human intervention.

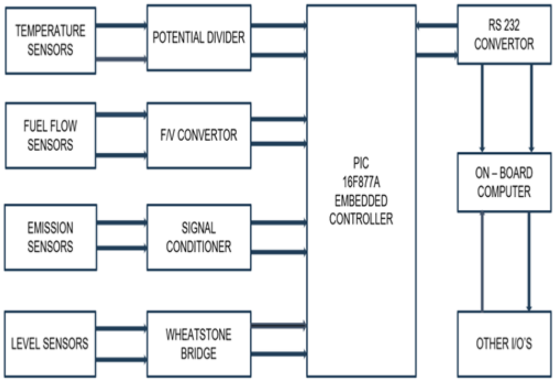

Fig. 2. Block Diagram of on – Board Diagnostics.

The above figure represents the block diagram of the proposed system various sensor such as temperature, fuel flow, emission & fluid level are used to capture vehicle parameters. Based on the sensor data, the system manages alarms, cooling, ignition and GSM alerts to ensure safety and reliability of the vehicles.

Comparison Table: Existing System vs Proposed System

Feature	Existing System (OBD-II Scanners)	Proposed System (OBC-Based Monitoring)
Cost	High (₹15,000-₹40,000)	Low-cost (Affordable for small garages & users)
Compatibility	Brand-specific (works for limited models)	Universal (Works for multiple car brands)
User Accessibility	Used mainly in service centers	Usable by any car owner or driver
Setup Requirement	Needs technician setup and configuration	Plug and Play – easy installation
Data Display	Shows only error codes (DTCs)	Displays real-time data (temperature, gas, emission, fuel, tilt)

IV. RESULT AND DISCUSSION

The proposed OBC – based in – cabin monitoring and controlling system was tested by simulating different vehicle conditions and observing the response of the controller. Each sensor was connected to the PIC16F877A, and the signals were processed through the MAX232 driver for reliable communication with the on – board computer. During testing, the temperature sensor successfully detected variations in engine heat, and when the threshold was crossed, the OBC activated the cooling unit automatically. The fuel flow sensor showed consistent readings, allowing the system to identify abnormal consumption that could indicate leakage or inefficiency. The emission sensor provided accurate measurements of exhaust gases, ensuring that the vehicle operated within environmental norms.

The fluid – level sensor for engine oil, brake fluid and coolant responded effectively by generating alerts when levels dropped below in safe limit. Similarly, the battery voltage sensor tracked variations in supply, and early warnings were issued during low voltage conditions. The tyre pressure sensor helped in monitoring vehicle stability, giving timely signals in case of pressure imbalance or tilt. The smoke chamber sensor was also tested, and it triggered immediate alarms when smoke was introduced, confirming its reliability in fire hazard detection. The GSM module was able to transmit alert messages to a pre – defined mobile number during emergency conditions such as over – temperature, smoke detection, or abnormal tilt. This confirmed the effectiveness of the system in real – time communication. Overall, the results showed that the OBC could process multiple sensor inputs simultaneously and execute control actions with minimal delays.

In prolonged testing conditions, the OBC prototype was operated continuously for extended durations to assess its endurance and consistency. The system maintained reliable operation without overheating or signal drift, confirming that the embedded hardware and sensors can withstand real world automotive conditions such as vibrations, temperature variations and electrical noise. The stability of the diagnostic output under such condition is crucial, as vehicles often operates in harsh and unpredictable environments. Furthermore, calibration checks performed after multiple test cycles indicated that sensors such as the NTC thermistor and orifice flow sensor retained accuracy, validating their suitability for long – term deployment. The experiments also demonstrate the advantage of integrating Multi – Domain Monitoring into a single onboard computer. While traditional diagnostic systems often focus on either electrical faults or emission levels, the proposed OBC combined parameters from mechanical, thermal, chemical, and electrical domains. For example, when emission level rose unexpectedly, corresponding data from the fuel flow sensor was simultaneously available to cross – check whether inefficient combustion was the cause. This multi – sensor correlation capacity offers more precise diagnostics and reduces the likelihood of misinterpretation compared to single – parameter systems.

Another noteworthy outcome was the OBC's Fault Isolation Capacity. During deliberate fault introduction, such as restricting airflow to the engine or simulating a partial short – circuit in the battery, the system not only detected the anomaly but also identified the subsystem responsible. This diagnostic precision is especially beneficial for maintenance personnel, as it reduces troubleshooting time and supports faster corrective action. Combined with GSM – based alerts, this capability ensures that both drivers and technicians receive specific, actionable information rather than general warnings.

The safety implications of the system are also significant. The ability to detect smoke, low brake fluid, or abnormal tilt conditions in real – time provides early warnings for potential life–threatening hazards. For instance, tilt detection through MEMS sensors not only alerts the driver but also issued a GSM based message in testing scenarios, ensuring that external parties were informed during simulated roll – over conditions. Similarly, the smoke chamber integrated with the exhaust successfully triggered alarms within seconds of smoke introduction, confirming the reliability of the system in fire-hazard detection. These safety features highlight the OBC's role as not only a diagnostic tool but also a preventive safety mechanism finally, the research outcomes establish the OBC as a promising IOT – ENABLED SMART MOBILITY SYSTEMS. By extending GSM based communication to internet enabled modules, data from multiple vehicles can be aggregated in the cloud for advanced analysis. The current results not only validate the present system but also open pathways for next – generation intelligent transportation ecosystems.

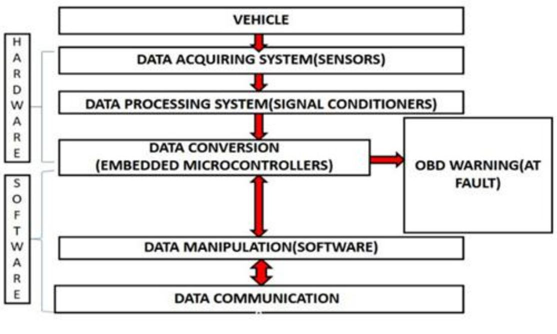

Fig. 3. Functional Block Diagram

The functional block diagram of the proposed system, shown in Fig. 2, consists of both hardware and software elements working together to ensure in – cabin sensing, monitoring and control. On the hardware side, the system begins with the vehicle as the source of different operating parameters. These parameters are collected by the data acquiring system, which includes sensors for temperature, fuel flow, emission and fluid levels. The raw signals from the sensors are passed to the data processing system, where signal conditioning circuits adjust the voltage levels and filter out noise. The processed signals are then forwarded to the data conversion unit, which is carried out by the embedded PIC16F877A microcontroller. This stage converts the analog signals into digital form for further use.

On the software side, the OBC performs data manipulation, where the digital data is analyzed and compared with predefined threshold values. The processed information is then transferred through the data communication unit, which includes GSM for external alerts. Finally, when abnormal conditions or faults are detected, the system generates an OBD warning, ensuring that the driver or monitoring unit is informed of the fault condition. Thus, the functional block diagram highlights the coordinated operation of hardware and software in achieving reliable vehicle monitoring and control.

By separating the hardware and software domains, the functional block diagram gives a clear understanding of how responsibilities are divided within the system. The hardware ensures that accurate data is captured from the vehicle & converted into a usable digital form, while the software ensures that data is properly communicated and interpretated.

V. CONCLUSION

The proposed system has been developed to enhance the safety, reliability and efficiency of modern vehicles. The system integrates multiple hardware and software components into a single framework, with the PIC16F877A microcontroller acting as the embedded controller and the On-Board Computer (OBC) serving as the central monitoring unit. The hardware side incorporates a wide range of sensors, including temperature, exhaust, fuel flow, emission, fluid level, battery voltage, tyre pressure, MEMS, and smoke detection sensors. Each of these plays a specific role in continuously tracking the vehicle's condition with the help of signal conditioning circuits such as potential dividers, F-N converters, Wheatstone Bridges, and dedicated drivers like MAX232, the raw signals are converted into accurate and usable inputs. These are processed by the microcontroller and communicated to the OBC in real time.

On the software side, the OBC performs data manipulation, applies decision – making algorithms, and generate appropriate control actions. This includes activating alarms, regulating ignition, controlling the cooling system, and generating OBD warnings in case of faults. The GSM modules ensures that emergency alerts are transmitted outside the vehicle, improving the chances of timely intervention in critical situations. The results obtained during testing conforms that the system operates with quick response, reliability, and accuracy. Critical scenarios such as overheating, smoke presence, fluid shortages and battery conditions are all defected effectively, and the system responded by triggering alarms or communication messages. Compared to traditional standalone monitoring systems, the integration through OBC reduces complexity, minimizes cost, and enables simultaneous handling or multiple parameters.

In conclusion, the project demonstrates that the integration of sensing, signal conditioning, embedded control, and communication within a single OBC framework provides a practical an efficient solution for in – cabin monitoring and safety in automobiles. The system not only addresses existing challenges in vehicle safety but also establishes a scalable foundation for adding features, making it highly adaptable to the evolving needs and modern transportation.

ENGINE TEMP 30
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 0.39
TURNING ANGLE LEFT 224
TURNING ANGLE RIGHT 153

ENGINE TEMP 89
EXHAUST TEMP 29
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 0.39
TURNING ANGLE LEFT 267
TURNING ANGLE RIGHT 163

Fig. 4. Result of Temperature Sensor

ON-BOARD DIAGNOSTICS
ENGINE TEMP 30
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 0.39
TURNING ANGLE LEFT 224
TURNING ANGLE RIGHT 153

ON-BOARD DIAGNOSTICS
ENGINE TEMP 30
EXHAUST TEMP 68
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 37
EMISSION 8.05
TURNING ANGLE LEFT 333
TURNING ANGLE RIGHT 188

Fig. 5. Result of exhaust gas temperature sensor

ON-BOARD DIAGNOSTICS
ENGINE TEMP 30
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 0.39
TURNING ANGLE LEFT 224
TURNING ANGLE RIGHT 153

ON-BOARD DIAGNOSTICS
ENGINE TEMP 31
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 9.98
TURNING ANGLE LEFT 226
TURNING ANGLE RIGHT 150

Fig. 6. Result of Emission sensor

ON-BOARD DIAGNOSTICS
ENGINE TEMP 30
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 36
EMISSION 0.39
TURNING ANGLE LEFT 224
TURNING ANGLE RIGHT 153

ON-BOARD DIAGNOSTICS
ENGINE TEMP 30
EXHAUST TEMP 28
ALTERNATOR VOLTAGE 0
BATTERY VOLTAGE 0
OIL QUALITY 1005
EMISSION 0.39
TURNING ANGLE LEFT 225
TURNING ANGLE RIGHT 152

Fig. 7. Result of Oil level sensor

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