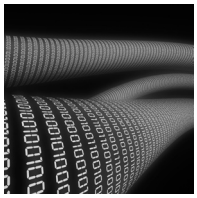

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Monitoring of diesel-electric locomotives - fleeteye-rail

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ABSTRACT
FleetEye-Rail is the system serving for monitoring of diesel-electric locomotive fleet. It locates locomotive position by the GPS technology, communicates with driver and acquires and processes various operational parameters.

KEYWORDS: locomotive, diagnostics, positioning, monitoring, telemetry, GPS, fuel, engine, fleet management

1. Introduction

System FleetEye-Rail it is an effective solution for the professional locomotive fleet management which offers locomotive's recording, engine's data monitoring and dispatcher managing. The system has been designed to meet customers' needs and requirements. It takes advantage of variety of system combinations.

Functions of this system can be divided into three main groups.

- Logistic functions resulting from the position monitoring of locomotives serving for capacity optimisation of each locomotive and of the whole locomotive fleet
- Functions serving for security against thefts of fuel and for optimisation of fuel consumption
- Taking and processing technical parameters for reduction of failure rate and for signaling driver's errors

2. System structure

The heart of the system is the on-board unit, comprising

- TDM computer device
- GPS positioning module
- GPRS data-transfer module
- Driver's communication terminal
- Fuel level sensors
- Various sensors e.g. tachometer, oil pressure, engine temperature

The TDM device processes locomotive information and sends it to the server. Data transfer from the locomotive to a user's PC occurs automatically via mobile operator's network. For operational and security snapshot records may be sent by two independent routes (GSM and GPRS). All data are saved to the database on a file server. The server application enables database network connection. Replication database enables client's connection via the Intranet or Internet (e.g. laptop).

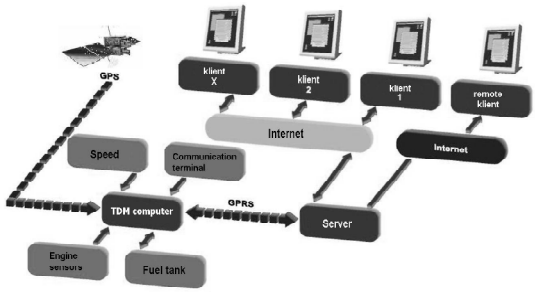

Fig. 1. Diagram of system structure

An active connection enables continuous online connection with the vehicle. Position recording interval is programmable from 5 seconds to 59 minutes 59 seconds with 1 second step. The snapshot record contains date, time, GPS position, speed (taken from wheels), states of connected or activated values, states of activated sensors, fuel losses or refuelling.

3. System functions

3.1. Logistics

Position monitoring - System users can monitor where the locomotive is operating, reasons and means of stopping, the aim of the journey etc. All locomotives are displayed on the map background which allows pinpointing of chosen localities, imposing restriction on certain area or retail in these localities (areas with lower maximum speed, restricted areas etc.).

Considering the fact that all data concerning each locomotive movement are recorded on the file server, persons responsible for system operation can also monitor locomotive movement retroactively. All the data about operation are set into graphical outputs or charts to make them useful, increasing productivity and reducing the operative costs of locomotives.

Login - For retroactive monitoring it is necessary to know the driver's identity. There are three methods of Login in: RFID chip card scanner, DALLAS chip card scanner or entering employee's personal number via communication terminal.

Dispatcher-Driver Communication - FleetEye-Rail enables logging in and communication between dispatcher and driver. GT2 communication terminal works on GSM or GPRS technology and enables:

- Voice calls
- Text communication
- Selecting the purpose of stopping or the aim of the journey from a predefined list
- Saving active phone calls list
- List of granted outwards communication phone numbers

3.2. Fuel losses and thefts

FLEET – EYE Rail minimizes the possibility of a theft or other fuel escapes (a loss due to accident, a tank perforation, …) from locomotive fuel system. The fuel tank in FLEET – EYE Rail system is equipped with two electromagnetic relay level sensors TR. These measure fuel level height in a huge tank. It converts a liquid level height into an electrically measurable value – the electrical resistance (an analogue signal). When there is any deviation in fuel consumption the alarm is activated and displayed to the dispatcher or security service. It allows a sufficient reaction time. In journey overview, such fuel loss is recorded automatically and can serve as proper evidence. The system also enables sending SMS messages reporting unwanted fuel losses to the chosen telephone number.

- The level indicator is installed in locomotive tank in the way approved by EZU
- The TDM unit records fuel quantity in the tank after each ride
- It identifies and records a refuelling in real time and that values can be compared with fuel pump values
- It identifies fuel losses from tanks in real time and amounts (in litres) 24 hours a day
- Monitoring of used fuel amount (during the ride), average consumption per 100 km
- with an accuracy of 0.5%
- There is no need to check electronically opening / closing of the tank lid (the level indicator is a tank lock on its own)

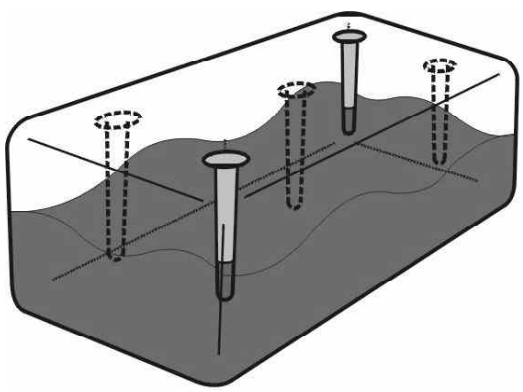

Fig. 2. Electromagnetic relay level sensors TR in fuel tank

3.3. Engine`s data monitoring and Traps

The system takes and processes various engine's data which serves for evaluation of each locomotive traffic or the whole fleet such as:

Level indicator data - measuring of a fuel level in a vehicle's tank, refueling of a vehicle, measuring of a fuel leakage, identifies vehicle's fuel consumption

Pulse generator input - a number of kilometers driven, speed monitoring, speed snapshot

Engine state connection - record of the engine's idling runs

Engine speed sensor connection - efficiency records, machine's versions, record of revolution running while driving

Exterior sensors' input - operating record completion, alarms' record, vehicle's detection of interference

A client SW provides multitude of information and functions regarding data which displays and processes. Since particular users differ in their needs, the FleetEye –RAIL system makes user groups' definition possible, with active functions that are attractive and useful to them. Therefore the users are not flooded with the useless information and the user interface offers only a selection of all existing functions. The system users can monitor the locomotive fleet operations on the map background or in graphical outputs or charts. The users software is modified into variants to satisfy individual customer's needs.

This function joins the previous functions and enables to highlight features the operator considers most significant. The system makes it possible to inform a dispatching centre or another user via short text messages about specific events e.g. alarms. A message contains an actual position along with a type of alarm.

Each user working with the FleetEye-Rail system is able to define own alarms, so called traps.

- Fuel losses
- Refuelings
- Stopping in restricted areas
- Standing still for more than X minutes
- Standing with running engine
- Uneconomic ride
- Rides in cold-engine mode

4. Conclusions

- GPS satellite monitoring and controlling
- Operational records
- Record of consumption and control of fuel indicators
- Active dispatcher – driver communication
- Data processing
- Possibility to export data into different file formats or to interconnect with customer information systems

The market competition forces prices down in every market sector. One of the most efficient ways to survive is to optimise the expenses.

All railway operators search for the optimal way, how to utilize their assets - engines and wagons. The reserves can be disclosed by technical means which provide operators with valuable information. Operational data must be available online, measured with adequate precision and presented in a very user-friendly way (every user has a tailor-made set of functions and views). The best fleet management systems must provide users with both online status and with statistical data.

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