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A REMOTE DIAGNOSIS & MONITORING SYSTEM USING INTERNET TECHNOLOGY

The construction and operation of the remote diagnostic system for traction vehicles and distributed electrical equipment are presented in the paper. The system consists of two versions of monitoring devices, software residing on central server machine with relational data base and visualization application. The possibilities of further development of the system and its areas of application are also discussed.

SYSTEM DIAGNOSTYKI I MONITORINGU URZĄDZEŃ Z WYKORZYSTANIEM SIECI INTERNET

W artykule zaprezentowano budowę i działanie systemu zdalnej diagnostyki i monitoringu pojazdów trakcyjnych i grup urządzeń elektrycznych. W jego skład wchodzą: dwuwariantowe urządzenie monitorujące, oprogramowanie centralnego serwera z relacyjną bazą danych oraz aplikacja wizualizacyjna. Omówione zostały również możliwości dalszego rozwoju systemu i jego zastosowań.

1. INTRODUCTION

The contemporary civilization is based largely on transport of goods and persons. The transport rationalization, especially in big towns, is one of the main subjects in scientific programs sponsored by The European Union. The goal in these activities is to convert the central parts of towns into citizen friendly transport areas by applying techniques leading to:

- reduction the number of urban communication failures and their repair times;
- new methods of urban traffic management;
- introduction of urban traffic information systems.

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A necessity of amelioration of urban communication is related to constant expansion of towns. The new house estates are emerging in suburban areas, which arise partially from limited space in central parts and partially from tendency to settle outside the center due to lower noise and minor environment pollution. It is vital for the habitants of these house estates to have the means of transport to the centers of towns. Using private cars leads to increasing the traffic in central areas, resulting in traffic jams and troubles with parking places. The public transport can be an attractive option of transport means for suburban areas, assuming it is reliable and allows efficient and easy movement in the whole town.

The main weakness of public transport in polish towns is weak punctuality, which is caused by traffic intensity (mainly personal cars) in certain hours and frequent failures of public transport vehicles or traction systems (for tramways and trolleybuses). In connection with this it is almost impossible to define the arrival time of the vehicle to the stop and the timetable on the stop is frequently worthless. Without actual information about the status and position of the vehicles the dispatch center cannot react appropriately to the situation and the passengers cannot take a decision to use other transport means than the one they have chosen.

There is a similar necessity to monitor important installations, distributed on wide area, which can be crucial to the people safety or environment protection. A good example of this kind of installations are water pumping stations on depression regions.

The goal for the presented system is continuous monitoring of the objects without use of mobile service and with minimal user costs. This goal has been achieved by using GPRS and Internet technology. Using Internet as a transmission platform makes it possible to omit expensive communication and monitoring software and the continuous monitoring of objects can be accomplished using standard terminal connected to the global internet network. As a terminal can be used for example PC computer equipped with standard internet WWW browser with Java virtual machine. The programming language for communication and archivisation software was Java.

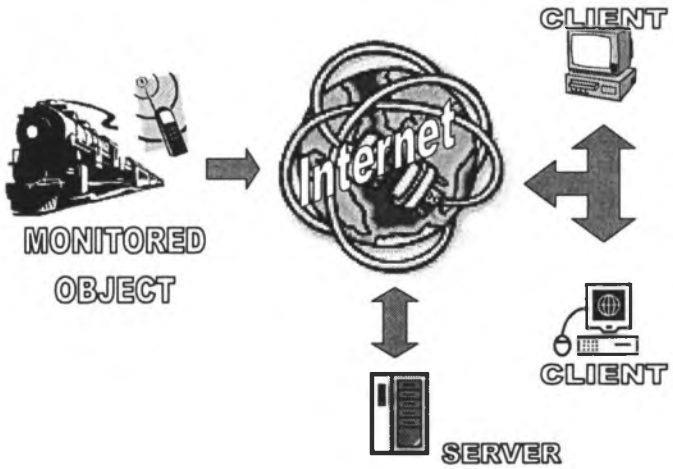

Fig.1. Monitoring system diagram

The system consists of internet sever, communication software, visualisation software and communication modules installed in monitored objects. The object data are collected on-line and relay to the wireless transmission module, which transmit them to the internet server. The data are registered then in data base residing on the server. The data from the database are available for authorized users as an internet service WWW.

Till now there are realized two WWW services:

- WWW service for the traction vehicles in Java applet and CGI script,
- WWW service for the experimental water quality monitoring system on Żuławy depression area.

2. THE CONSTRUCTION OF MONITORING SYSTEM

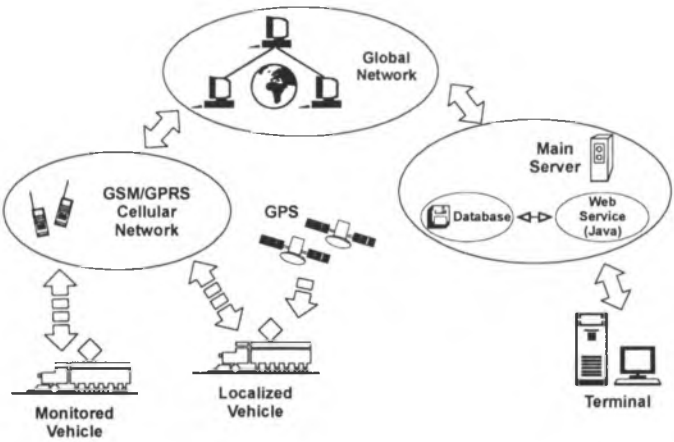

Fig.2. Monitoring system presentation

The implemented on the communication server algorithm operates for many users in the same time. The immediate monitoring of the object status creates a possibility to observe the changes in object on-line during its operation. The information about changes in monitored object is updated simultaneously for all connected users.

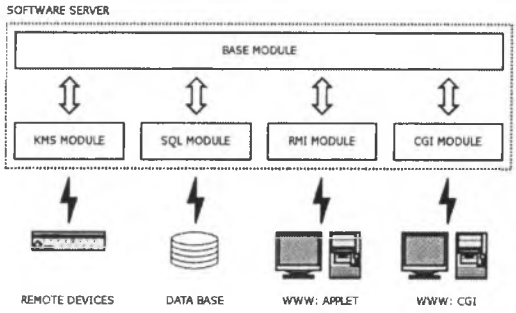

Fig.3. Internal server architecture

One of the main system components is visualization software for data collected in server database. The assumption for visualization system was multiplatform operation therefore it was created as Java applet. Thanks to this property it can operate on any computer equipped with virtual Java machine independently on operational system. To start the application software only standard internet browser is necessary.

2.1. VISUALIZATION USING JAVA APPLET

Actual traction vehicle monitoring applet version allowing advanced and intuitive analysis of the data collected in server database was created in cooperation with client.
It can display all the important data which are necessary to define the actual state of the vehicle like supply voltage, battery voltage, currents of the drives, actual speed, active failures and many others. The data are logged to server database each 30 seconds during operation of the vehicle. Some examples of dialog windows created in internet visualization application are presented below.

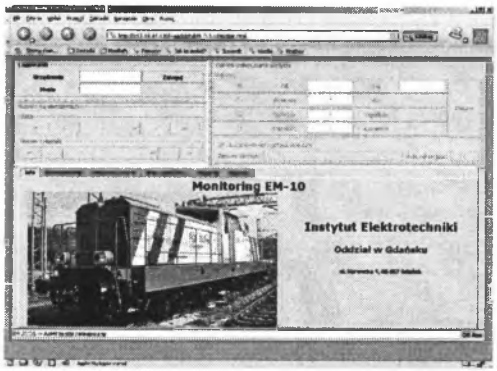

Fig.4. Visualization interface for data collected in server database

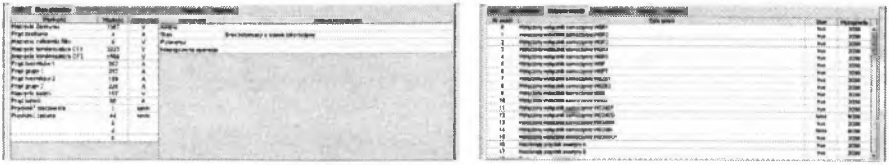

Fig.5. Dialog screens "Actual State" and "Active Failures"

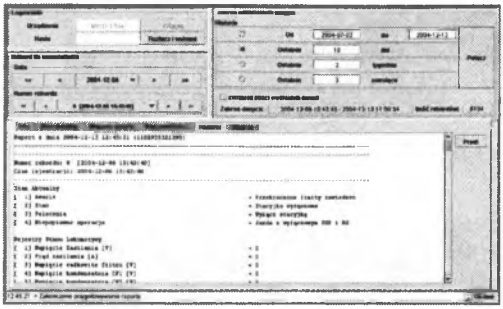

Fig.6. Report screen

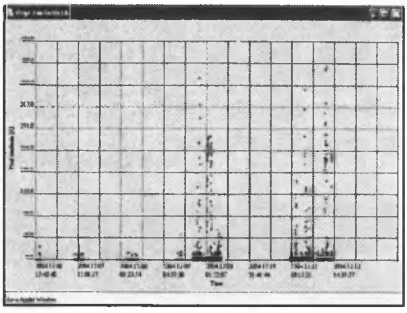

Fig.7. Supply current diagram screen

2.2. VISUALIZATION USING CGI SCRIPT

WWW pages dynamic generation was the first practical task using communication technique applying integration module. The HTTP server starts the appropriate CGI program on internet browser request. After start of CGI program the connection to the integration module is opened and the request is relied to the database module. The result of the operation is given back to the CGI program, which generates WWW pages and through the HTTP server makes it available for the client. After successful login the user passes to the device select page. This page contains all the devices for which the user is authorized.

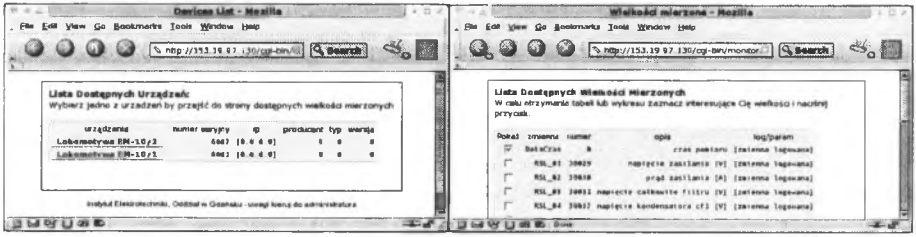

Fig.8. Examples of user device control screens

The device select page contains also additional information describing controlled devices like the name of the device, its serial number, static IP address, producer type and version signature. Each device has a number of available control parameters. The data related to the respective parameters can be presented in the tabular or diagram form.

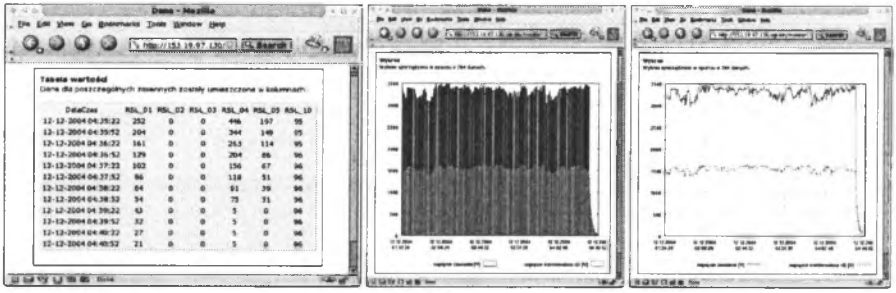

Fig.9. Data presentation in tabular and diagram form

3. THE DEVICES FOR REMOTE MONITORING OF TRACTION VEHICLE

The tasks of the monitoring device include collecting diagnostic data from the vehicle controller and sending them to server, which performs their archivization in database. In case of communication with server failure (no GSM signal, server failure) the collected data are temporarily archivized in internal device memory to be sent after reconnecting.

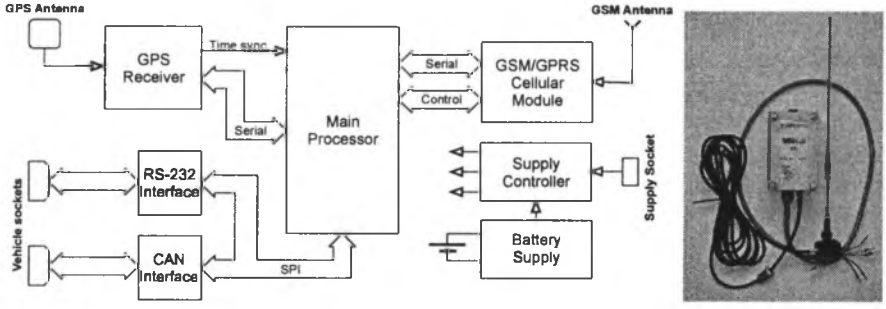

Fig.10. Schematic diagram and view of the monitoring device

The central processing unit is based on AVR Atmel microcontroller of RISC architecture containing inside a number of peripheral interfaces including two hardware serial interfaces UART.

The cellular communication module is connected to central processing unit through UART interface using extended and modified for GSM/GPRS purpose Hayes-AT command set.

The position is resolved with 15m accuracy using integrated GPS receiver equipped with external active antenna. The GPS module is connected to central processing unit through UART interface. The central processing unit is taking chosen set of vehicle operation data in

programmed time intevals from the PLC vehicle controller through CAN network interface. It is possible also to connect to PLC controller using RS-232 interface (MODBUS-RTU or other protocol). The collected data are converted to the form acepted by the communication protocol and transferred to be sent by GSM/GPRS communicatiopn module.

The inputs of the monitoring device are gavanically separated which increases the disturbance immunity and reliability of the device.

The device is placed in sealed and mechanical resistant case. All outside cable connections are sealed as well.

4. CONCLUSIONS

The presented monitoring system has been applied in cooperation with Electrical Traction Department ofThe Electrotechnical Institute in electrical locomotives EM-10 type owned by DOKP Gliwice. This application means opening of the way to wider usage of applied internet technology for remote monitoring and control other industrial installations.

Fig.11. Choice of measurement point screen

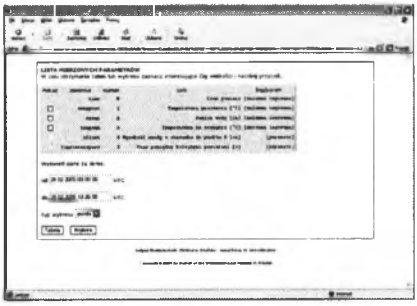

Fig.12. Choice of parameters screen

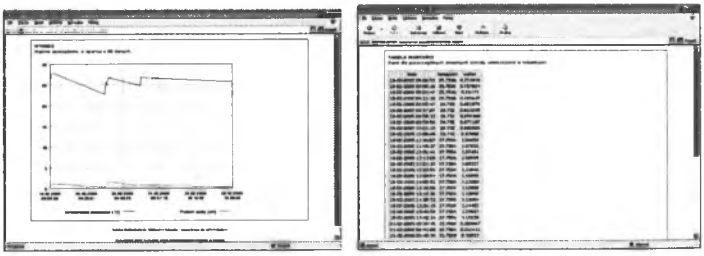

Fig.13. Tabular and diagram form of data presentation

The developed for this task purpose system structure based on the central server is also used for other tasks related to distributed objects control like i.e. experimental system for monitoring the water quality on Żuławy depression area.

The developed system is similar to traction vehicles monitoring system in its CGI version. After successful login user can choose the measurement point from the area map and then the time interval and parameters which can be presented in tabular or diagram form.

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Reviewer: Ph. D. Stanisław Krawiec