GPS REAL TIME MONITORING OF CARS
DURING 62ND RALLY POLAND IN 2005

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Abstract

The paper presents the preparations work and experiences gained from realtime GPS car monitoring during the European Rally Championships organized on 10-12 June 2005 in Poland. The developed system is based on GPS and GSM/GPRS technology. Distribution and teletransmission of data are possible using different GSM operators in Poland, which makes the system fully independent. The system's server collects data from rally cars, processing and send data through VPN connections to the SQL server located in main control room. Data can be collected in real time via Internet or GPRS. Some information on GSM/GPRS range during rally championships are also presented in the paper. The study covered many trials and tests of different software and various configurations of the GPRS modems before finally the system started to work. Information coming from 10 Rally Cars were collected to the SQL Server continuously in one second interval. In real time mode these all data were displayed simultaneously in the rally main control room and in the rally press conference room. Paper describes also adopted emergency procedures and remote reconfiguration of GPS/GPRS boxes inside rally cars made during championships. Some problems and method of practical solutions are presented to avoid active jamming dangerous for a driver and his pilot, having system of communication intercoms jammed by teletransmission of GPRS 900/1800 MHz. In cooperation with rally teams special GPS/GPRS safety boxes were designed and made. Monitoring of all 7 rally stages with GPS receivers and method of calibrations of the maps were presented. GSM signal coverage was also checked in all stages. All data transmitted from rally cars were recorded in the computer. Some of our GPS cars had accidents and dispite them information were continuously sent to server. There is

possibility to show in post mission mode the position of chosen cars in our rally application. Some information of best rally cars are presented also in the paper.

1. Poland Rally Championship.

Rally Poland is the second oldest Rally on the World (www.rajdpolski.pl) and also qualifying round to European Rally Championships. It is located in the North-East region of Poland (Fig. 6), 200 km north of Warsaw and 180 km south-east of Gdańsk, not far from the Polish-Russian border and from Kaliningrad district. The region is famous for its history, as well as for unbelievably charming glacial landscapes,a multitude of lakes, including Great Masurian Lakes, and forests covering a large area of it. For the reasons, the Warmia and Mazury region is frequently refered to as a "Land of Thousand Lakes" or the "Green Heaven of Poland". It is also a leisure centre for more than one million domestic and Western tourists every year.
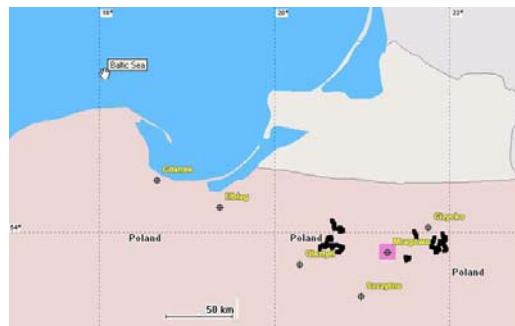

Fig.1: Location of Rally Poland in North-East Poland.

2. System Preparation and Results.

Before the experiments on the rally cars, GPS kinematic one-second interval measurements of all 7 rally stages were performed (Fig. 7) and calibration of the maps was made (Fig. 8).
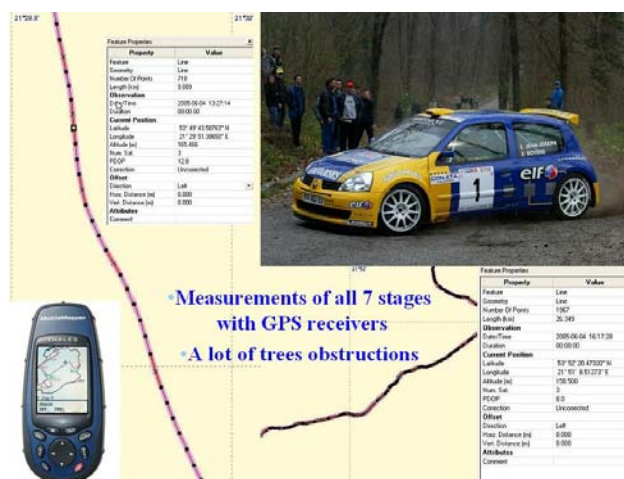

Fig.2: Collecting the data of all 7 rally stages.

At most the time the number of visible satellites didn't exceed 3-5 because of trees obstructions.
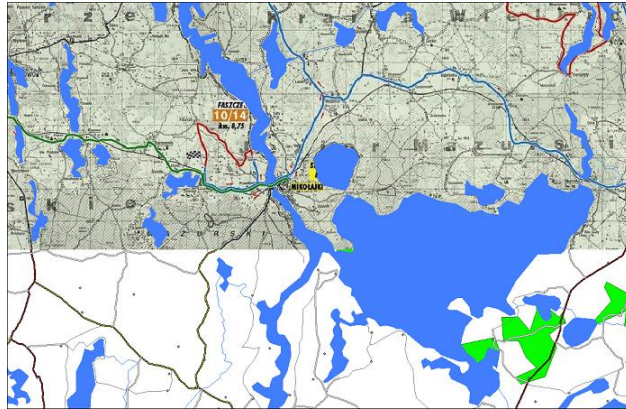
Fig.3: Calibration of two existing maps and 7 rally stages.

During all measurements a coverage of GSM/GPRS signal of three GSM operators existing in Poland was checked. Some of areas, especially unurbanized, didn't have sufficient GSM/GPRS coverage for teletransmission data (Fig. 9). Many GPRS terminals such as mobile phones don't have a self-test connection option which is necessary to be automatically reconnected to the GPRS network in case of lost of GSM signal. This option was implemented by hardware inside our black boxes. We reconfigured GPS+GPRS components with AT modem commands to check every 3 minutes whether GPRS connection was established. In case of lack response from APN (GPRS Access Point Network) GPRS terminal had a task to send enquiry again. In case of silent a terminal GPRS had a task to immediately restart. After consultations with famous polish driver Krzysztof Holowczyc in his garage in city of Olsztyn a special designed GPS boxes were designed and produced (Fig. 10).

Fig.4: Testing GSM/GPRS coverage on all 7 rally stages.

Fig.5: Design and production of GPS boxes.

Serious safety problem was developed during tests with various models of rally intercoms. GSM/GPRS can jam some intercoms and in this case driver and pilot make sick during the noise sounds in their ears. Of course while jamming they're cannot communicate each other. A jam occured every second when GPRS terminal had tried to send informations to the server. The solution for that problem is to check which intercoms are jammed or to use a special designed ferrite throttle, but in both solutions we need a lot of time. At last we have found that only one model of intercom was jammed during the tests of all intercoms of 10 rally drivers (Fig. 11). Finally GPS antennas were gummed into the car's roofs and GPS receivers were screwed down in different places inside the cars e.g. on the back floor behind the seats, under the seats, in the luggage boot. (Fig. 12). Data can be collected in real time via Internet or GPRS. Information coming from 10 Rally Cars were collected to the SQL Server continuously in one second interval. In real time mode these all data were independently displayed simultaneously in the rally main control room and in the rally press conference room located in one of largest Hotel (such as coordinates, rally ID, velocity and time).

Fig.6: Serious safety problem during European Rally Championships with GPRS jamming.
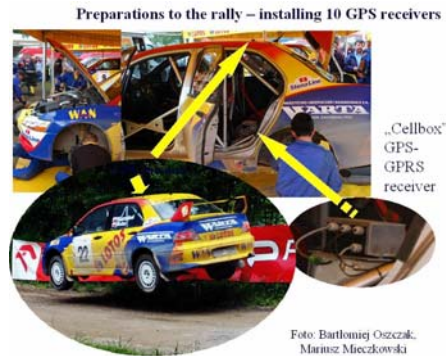
Fig.7: Localisation of GPS components on the cars.

E.g. when in the PRESS ROOM was shown maximum amount speed of chosen car in the same time in the MAIN RALLY CONTROL ROOM stuff could observe general situation of a rally (Fig. 13).
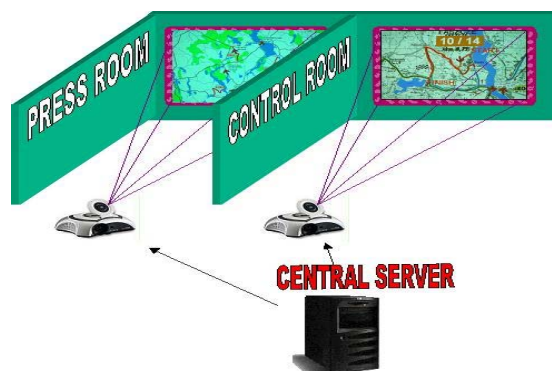

Fig.8: Different screens are displayed simultaneously in the press room and the rally control room.

We used server-based application specially designed for the Rally Poland (Fig. 14). There is possibility to show in post mission mode the position of chosen cars in our rally application. Some of our GPS cars had accidents and dispite them information were continuously sent to server.

Fig.9: Real time GPS monitoring of rally cars during European Rally Championships.

All data transmitted from rally cars were recorded in the computer in SQL base (about 60 Megabites of text informations). Good news was that the rally drivers had synchronized official start times with a GPS time, so a comparisons of results were easily done (Fig. 15).

From day one of GPS monitoring there was an emergency situation because the main Internet connection located in Hotel which collected all informations from rally cars through VPN link had broken down in conference rooms. adopted emergency procedures and remote reconfiguration of GPS/GPRS boxes inside rally cars made during championships.
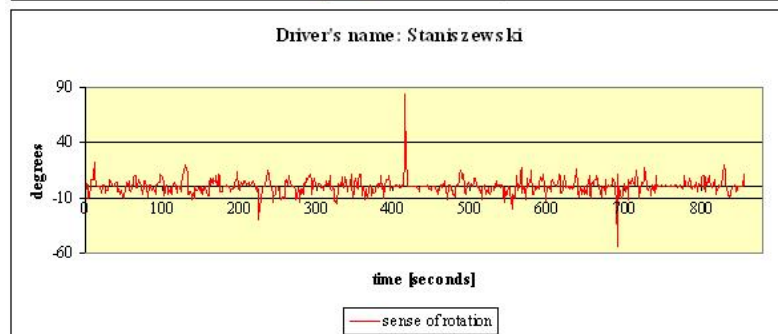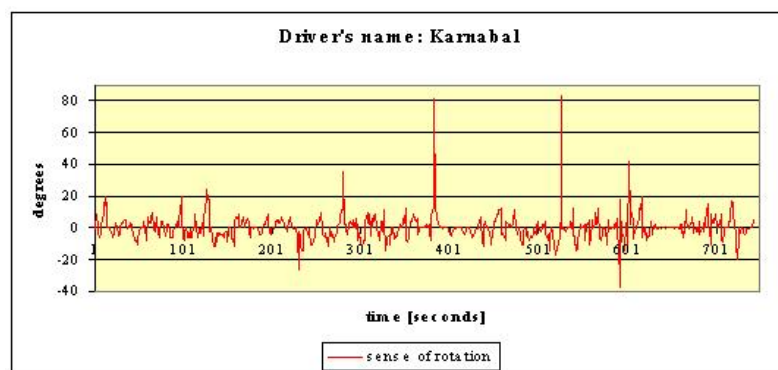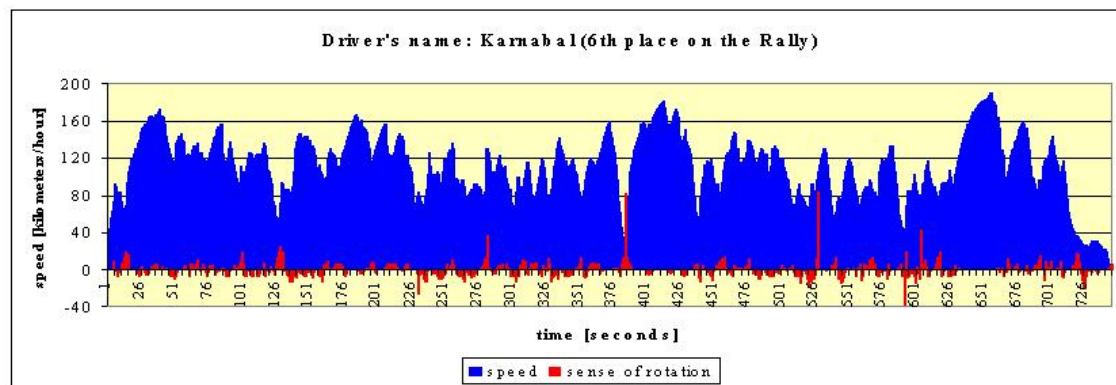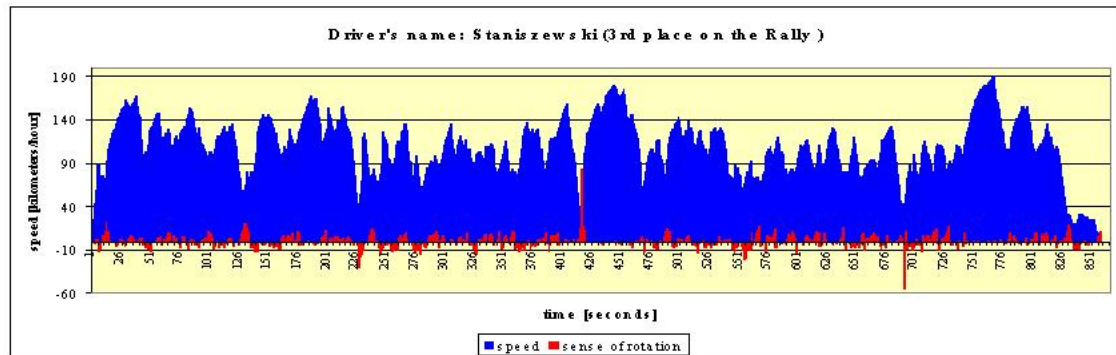

Fig.10: Comparison of two the best rally drivers equipped with GPS components.

3. Conclusion.

Presented system has shown that GPS/GPRS techniques could be adopted for positioning and monitoring of the fast moving objects such as rally cars even in the hilly and wooded areas. It also may be used as a diagnostic tool in the professional training of the rally drivers.

REFERENCES

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