Intelligent sensor network for wind potential asset

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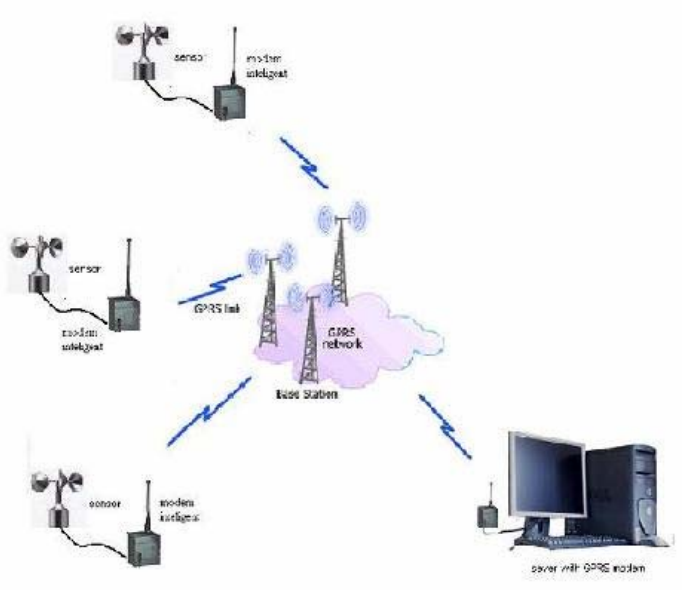
Abstract

In the ReSI (retea de senzori inteligenti) we developed some new approach for wireless SCADA projects, that comes as a response to market demands. One of these approaches is to put together the sensors with an intelligent GPRS modem with 'other glue" electronics like PLC.

Keywords: network, wireless, sensors

1. Introduction

Generally speaking, wind equipment emplacement comprises at least two distinct phases: i) established wind area, ii) accurate location of pillar generator. The first phase is referring to the *gross emplacement*, in a geographical area, limited by the coastal and hilly zones, and is not a problematic one. The second phase is referring to the final emplacement, meaning that we already know the area and we want to establish the foundation of the wind generator pillar. The current way of the wind potential assessment assumes many direct measurements in the area. For this we set up an ensemble of monitoring wind potential, named ReSI (Retea de Senzori Inteligenti).



This ensemble is compound of many remote intelligent sensors that communicate via GPRS with a server, the server gathered the information in a data base; the data base is reachable through internet. This structure can be seen in the figure nr. 1.

The connectivity between units is done through GPRS service, and is assured by a GSM company. All the units are in a VPN operation rule. The connection paid is limited to 64kbps, but is more than enough.

Fig 1. Intelligent sensor network for wind potential assement

2. The intelligent remote sensor.

The intelligent sensor tied together two pulse anemometers (NRG #40) and a wind vane with a GSM/GPRS telemetry engine. Changing the sensor this type of remote unit can be used in many other ranges like water supply and distribution, energy metering, gas pipe line monitoring and so on. Through such approach we open the door to many industrial and civil applications. The telemetry engine or the so called intelligent modem has besides a GSM module and an embedded processor. This processor assures analog-digital conversion, discrete I/O sensing and pulse countering. Currently we used a Telit GPRS modem with Python facility, but the limitation we face has pushed us to find better solution. There are many GPRS modem with incorporated

processor able to model a telelemetry engine (see figure 2) that has: 2-8 digital inputs, 2-8 digital outputs, some pulse counter (32 bits) inputs, 1-4 analog inputs, even 1 ADC as option an analog output, 128kbyte or more flash memory and RS232 interface for PC monitoring and logging software.

The sensor NRG#40 doesn't consume energy; its pulses are generated by magnet moving under wind action.
These remote units are powered by 50W photovoltaic panels that charge a 12V battery with a capacity of 7,2Ah. This capacity is intended for 3-4 days autonomy without photovoltaic charging current.

Fig 2 GPRS modem with processor

3. The ReSI data base

The interaction between measurement/acquisition and storage entities have to be at a high standard in order to ulterior permit a proper and adequate exploitation of stored data. In order to obtain this objective it was used as database SQL server Server 2005. ReSI system presents a distributed architecture which makes the most appropriate to offer services regarding storage and data flow management handled at systems level. By using this database server the network traffic will be significantly reduced, weak and fragile mechanisms will be eliminated through transactions and it will be improved concurrence support. Also, through this system it is applied client/server model at a higher level, that of applications.

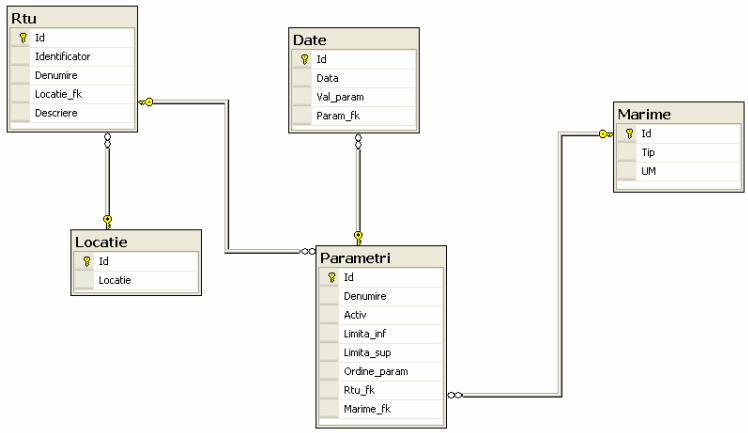


Figura 3: DataBase diagram

The data base structure corresponding to ReSI system is relativly simple, being composed of 5 tables from which 4 contain characteristic elements about the components used for measurement and acquisition and locations where can be found. (Locatie – the location of each device, Rtu- the devices main characteristics, Parametri – the parameters corresponding to a device and Marime – the values of the acquired parameters) and a table Data in which are stored acquired values from measurement point from the corresponding locations of ReSI system (Figure 3). Each table from the presented diagram in figure 3 contains a primary key of integer or real type in order to easily permit indexing, rapports and quick and efficient data searches. Also each table contains fields which represent foreign keys through which it can be determined in any moment data corresponding to any type of RTU or the location from where RTU's come.

At database level there are developed certain mechanisms such as stored procedures or views though which it is allowed the database exploitation to obtain the best results and also to

ensure an ideal interaction between ReSI system application and database server. The system's database design was realized in close connection with the specifications hat has to be met by ReSI application with the purpose of satisfying as accurate and efficient as possible the final user requirements.

4. The ReSI web application

From the desire to offer an access as secure as possible and to reach a target public as big as possible for database exploitation corresponding to ReSI system it was realized a Web application capable to multiple usages. In present the Web application manages acquired data only from Cluj-Napoca and allows on-line access to it. The Web application though the acquired data allows the realization of statistics based on which it can be observed the parameters variation acquired from RTU entities which are placed in the system.

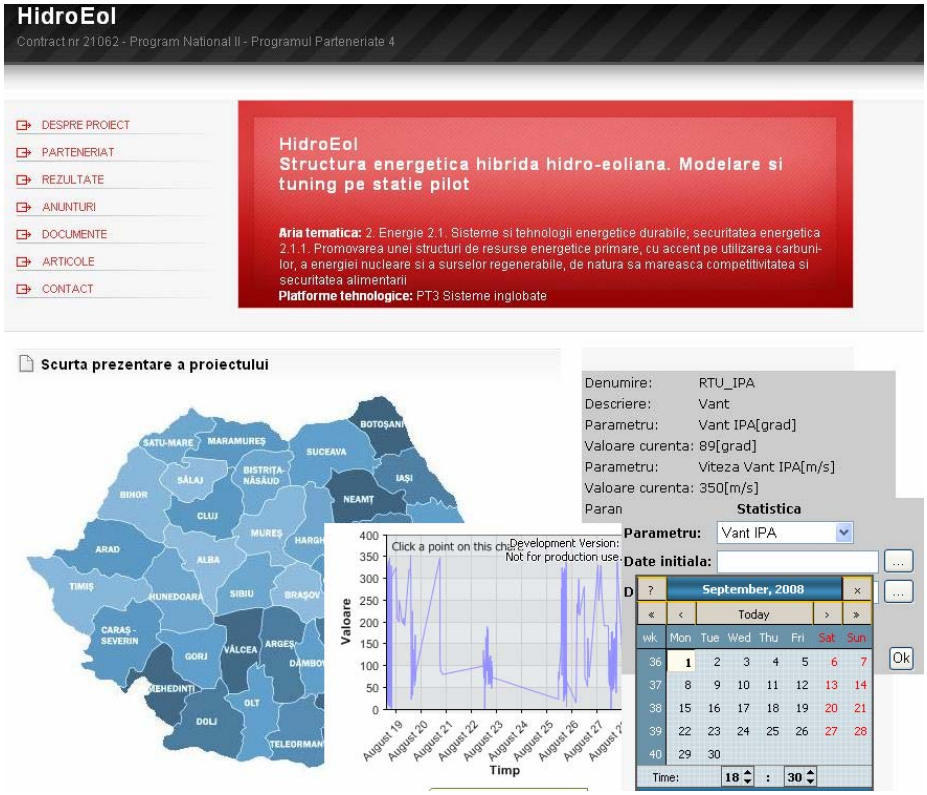


Figure 4. One of the ReSI soft applications, on-line meteo station from Hidroeol project

In order to permit users on-line access to stored data on the database server it was used Web Microsoft IIS server (Internet Information Services) version 6.0. This represents a very efficient Web server, available in all versions of Microsoft Windows Server 2003, which assures a safe infrastructure, scalable and also easily handled, destined to Web applications. IIS 6.0 allows several Web applications to run, in a quick and easy manner, and also ensures a high degree of performance of the platform dedicated to developed application in environment like Microsoft ASP.NET and Microsoft .NET.

In addition to the above presented facilitations, thorough Windows Server 2003 Service Pack 1 (SP1), IIS 6.0 dispose of the advantage of high compatibility, capabilities of log extension file generation, offers a high degree of security, having also other important characteristics. IIS (Internet Information Services) transforms a computer in a web server which offers publication services WWW (World Wide Web), FTP services (File Transfer Protocol), SMTP services (Simple Mail Transfer Protocol), and NNTP services (Network News Transfer Protocol).IIS can be used for web site hosting and management and also other Internet contexts once an IP address is obtained, it is registered the domain on a DNS server (Domain Name Server), and it is configured the network in an appropriate mode.

For the Web application which implements the functions described above, it was chosen Visual Studio .NET environment. In Visual Studio .NET development environment is allowed the implementation of .NET application, this being closely integrated with .NET Framework an run-time. The implemented Web .NET application is independent of the development environment which increases the portability of the application and also source code. The application that was developed, through its nature, is an open application which allows easy realization of modifications and improvements. .NET presents inter-language integration and exception handling, program debugging and forming, improved security, more efficient work with versions and a more efficient beneficiary installation. It offers a brand new model for interaction between components and class libraries - .NET Framework. .NET unifies the programming model, making from chosing a language a problem mainly of personal preference. At all .NET applications disposition there is a single library of classes, commune, coherent and elegant.

.NET applications are realized with the help of ASP.NET and ADO.NET tools of the .NET technology. The access and data presentation represents main functions which have to be implemented by a Web application. For that reason, taking into consideration that the application that was implemented has overtaking functions, and data visualization needs the usage of an infrastructure which offers automatic connection between data sources and application elements. In .NET, several efficient controls connected to data allow to associate easily data lines with HTML elements like list boxes or tables. The ASP.NET and ADO.NET capacities are obvious when using server controls in the context of Web application. The controls connected to data and code for data management is used in the same way independently of programming model. – Windows Forms, Web Forms or even Web services. This technology has many advantages for the programmer and also for final user. The main advantages which are presented to the user of a website implemented in ASP.NET are: enhanced functionality in database handling, more efficient and quicker web applications, protection against “memory leakage” and errors and support for a diversity of programming languages.

5. Conclusion.

The way open with ReSI could be easily adopted in many other industrial applications like water supply, gas pipe line monitoring, energy metering, food and chemical process, meteo and environments network.