BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LX No. 3B/2008	61 - 66	Seria Tehnică

Remote Control System for Pumping Units

Gabriela Bucur*, Marin Anica**

* Universitatea Petrol –Gaze din Ploieşti, B-dul Bucureşti nr. 39, Ploieşti
e-mail: chiri@upg-ploiesti.ro

** S.C. Digitline Automatizări SRL, str. Băneasa nr. 2-6, Bucureşti

Abstract

This paper describes a solution for a remote control and monitoring system of pumping units. The final objective is the hardware and software implementation for this system using the digital technology, fixed and mobile date networks and a TCP/IP and GPRS Protocols. The monitored parameters will be processed for a superior protection of pumping units. The communication system will permitted the online control and supervision. The local equipments will be connected thru network cables or GPRS Modems.

Key words: *control, monitoring, digital technology, data transfer protocols*

Introduction

This paper describes the implementation of local control equipments for pumping units and the connection of those in a flexible and modern system, using the most advanced hardware and software technology.

The monitored parameters will be processed, ensuring the protection of the pumping units. The communication system will allow on-line control and supervising, for an unlimited number of pumping units. The local equipments will be connected by cables or GSM/GPRS modems, according to specified conditions. The remote supervising functions will be accessible by fixed or mobile calculus systems.

Equipment Configuration and Functions

The configuration system is presented in figure 1, where BAPR is power and protection block, S – power source, AP – programmable logic controller (PLC), BCPT – control and overload protection block, BM – measurement block, MT – transmission block and M – pumping unit engine.

The PLC is AL2-24MR-D type. It has 8 analogical inputs, 7 numerical inputs, 9 relay outputs, local display for programming and visualization, programming interface for PC and communication interface.

This PLC carries on local supervising and distance communication with a calculus system. For remote data reading and changing the initial values, the equipment uses RS232 communication interface and the instructions of a specific protocol. For errors transmission and detection, the

format of instructions includes a checksum, witch is verified upon reception. Every error is shown to calculus system [2].

For remote control and communication, one dedicated memory zone was implemented on PLC level.

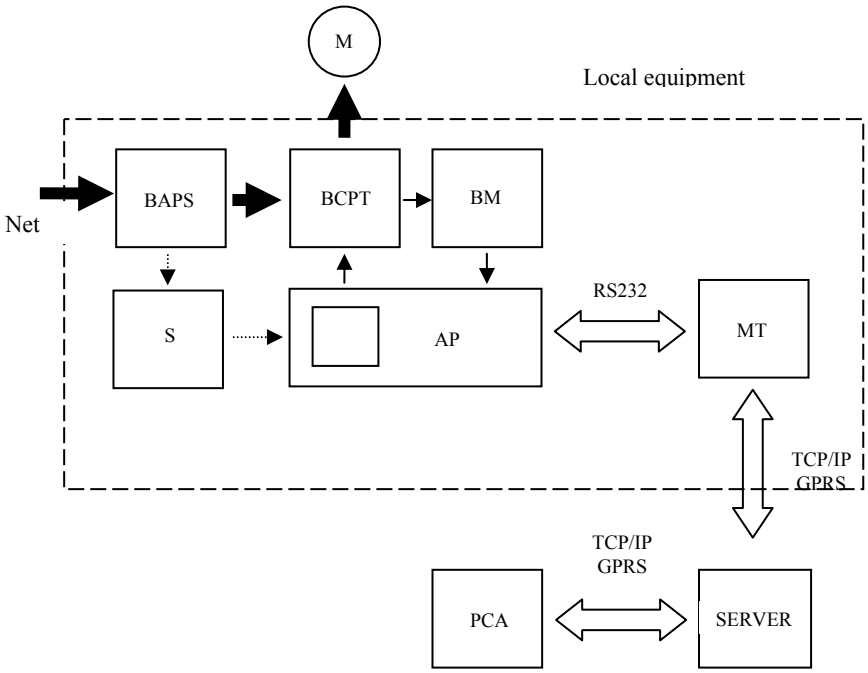

Fig. 1. The configuration system

The PLC software permanently updates the communication memory content with measured values or calculated values and reads from this the state of command elements and the configuration of local or distance updates [1].

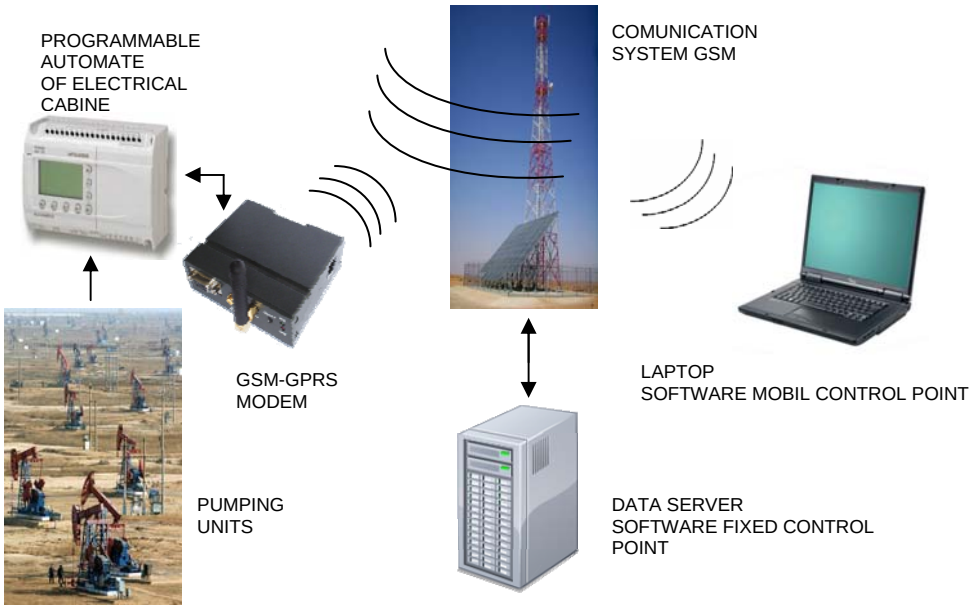

Fig. 2. The communication system between pumping units and command camera

Using the TCP/IP protocol, the software sends to PLC, thru communication system, the dedicate protocol instructions and receives the answer. In this mode, every location of communication memory is accessed bidirectional obtaining the real time control for all monitoring units. Accessing the units can be done in the automated read cycle or with manual selection [3].

The communication system is presented in figure 2.

The local equipment has the following functions:

- starting and stopping phases for engine M;
- automated return to the initial condition in case of power interruptions;
- voltage and current measurement;
- minimum and maximum current values for every pumping cycle;
- engine protection during the starting sequence;
- engine protection during the pumping cycle;
- time monitoring function;
- bidirectional remote communication by cable or GSM.

The local equipment is designed to work independent or connected with the control center through Internet Network. According to specified conditions, the connection to the system will be done using RS232 – Ethernet convertors or GSM modems.

For cable connection we use a RS232 – Ethernet converter. An IP address can be assigned to this equipment for connection to the calculus system through surveillance program.

The connection between PLC's RS232 port and the converter's RS232 port was realized with an adapter cable, with the following scheme (figure 3):

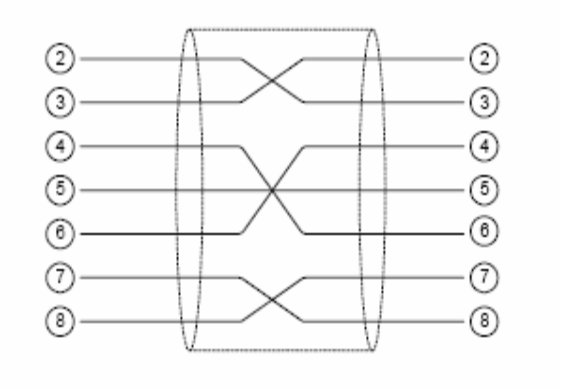

Fig. 3. Adapter RS232 cable scheme

The converter can be connected to the Internet by cable, with standard configuration, or can be directly connected on calculus system by crossover cable with the following configuration (figure 4).

The GPRS service \provided by local GSM networks was used for wireless data transmission. The hardware used is the EZ863 GSM-GPRS modem. After powering the equipment, the connection between GSM modem and IP address of control center is done automatically. The programming sequence for Vodafone operator is:

```
at+cpin=”1234”
at+cgdcont=1,"IP","internet.vodafone.ro","0.0.0.0",0,0
at#passw="vodafone"
at#sktset=0,999,193.25.104.154
at#sktto=0
at#sktop
```

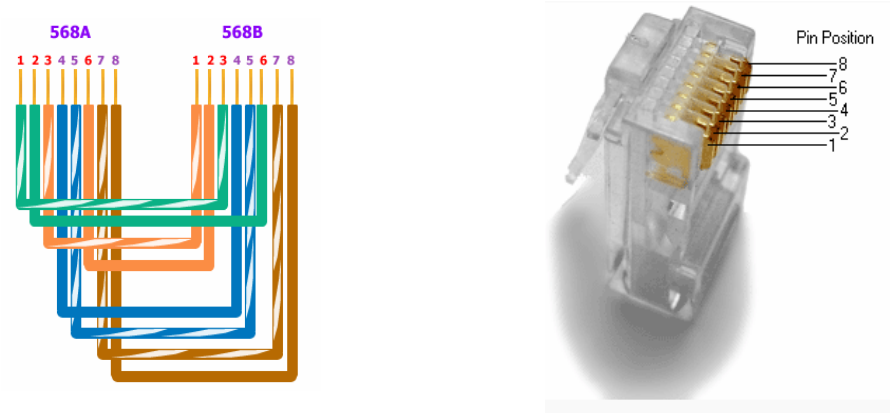

Fig.4. Ethernet crossover cable scheme

Surveillance Program

The surveillance program is developed in VC++ and has the following functions:

- local unit selection (automatically or manually);
- sending the read and write commands to local units requesting the analog and digital inputs and configuration parameters;
- receiving data from local unit;
- operator interfacing.

The write and read commands complies with the protocol format, specified to the programmable automates. For a compact transmission, the analogical data is stored in communication buffer and then transmitted in one single response to a read command.

The operator interface is presented in figure 5 and figure 6.

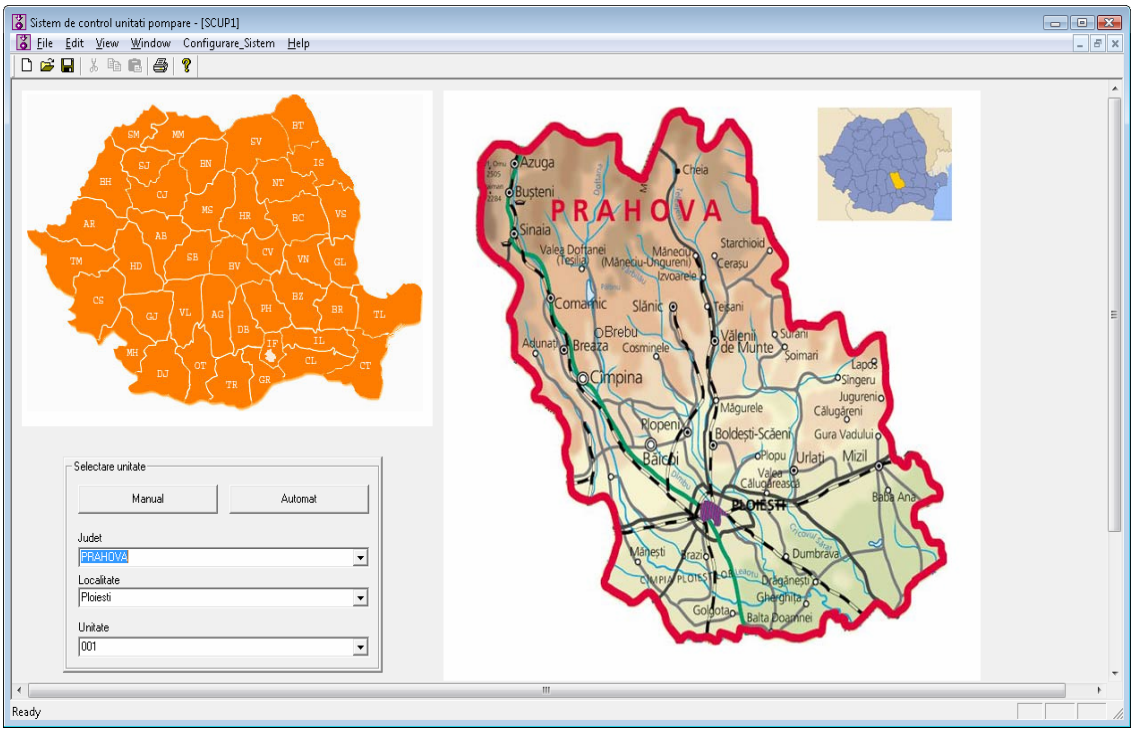

Fig.5. Unit selection interface

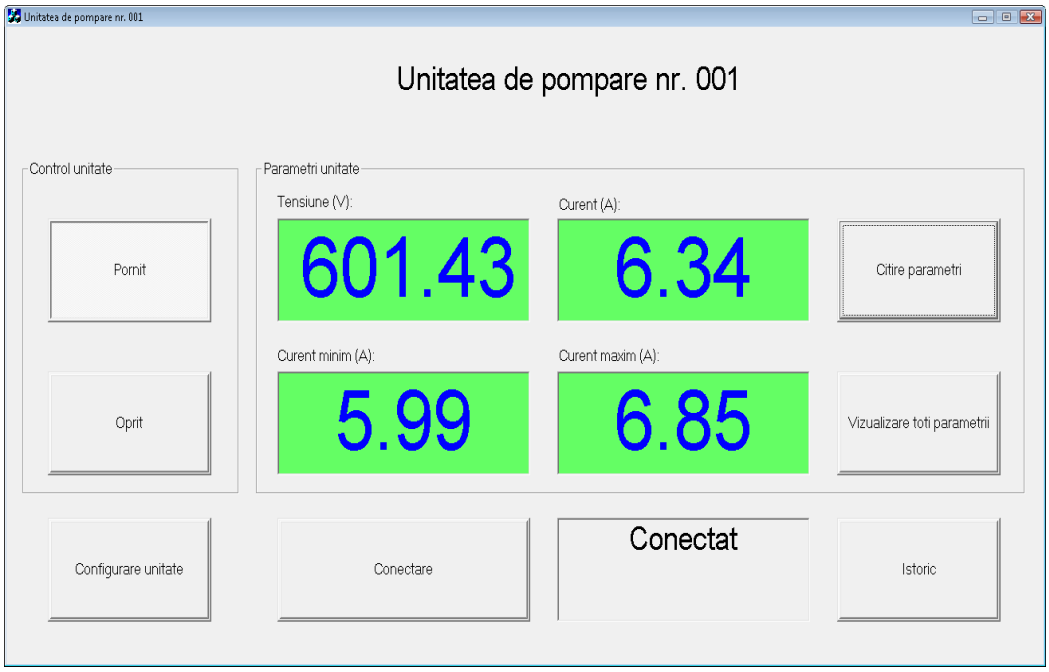

Fig.6. Surveillance units interface

An example for monitored parameters history is presented in figure 7.

Trend Samples

Signal File: Motor1 Aug/14/2008 10:46:16

Time	L1 current	L2 current	L3 current	L1 voltage	L2 voltage	L3 voltage
[s]	[A]	[A]	[A]	[V]	[V]	[V]
3	0.1	0.3	0.3	611.2	599.3	591.5
3.33	0.4	0.7	0.5	610.9	600.1	591.5
3.67	0.62	0.68	0.72	610.9	600.7	591.7
4	1.58	1.72	1.79	611.7	600.1	592.4
4.33	2.64	2.91	2.98	611.8	599.8	592.7
4.67	3.75	4.15	4.23	612.1	599.9	592.8
5	4.3	4.77	4.8	612.4	600.3	593.2
5.33	4.45	4.95	4.97	612.9	600.5	593.2
5.67	4.02	4.48	4.5	612.3	600.7	592.1
6	3.64	4.07	4.09	612.1	601.2	592.5
6.33	3.31	3.71	3.72	611.7	601.2	592.5
6.67	3.29	3.69	3.71	611.9	601.5	593.1
7	3.21	3.6	3.62	612.5	601.7	593.2
7.33	3.21	3.59	3.61	613.1	602.1	592.9
7.67	3.14	3.52	3.53	612.7	602.1	592.7

Fig.7 . Monitored parameters history in Excel format

Conclusions

This system offers facilities and functions designed to improve the equipment performances and to optimize the extraction activity such as:

- reduction of starting times and maintenance times;
- reduction of failure rates for engines, equipments and electrical lines;
- reduction of surveillance and maintenance costs;
- reduction of electric consumption;
- monitoring of interventions quality;
- real time information for all command levels.

Using the Internet and fixed or mobile connections with pumping units we can obtain an efficient control, without distance limitations. We can easily realize these equipments are versatile and have a lot of applications in different fields of activity.

Knowing the mobile Internet performances, the presented solutions for communications can be used in remote areas, without available infrastructure or electrical power.

References

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2. Moise, A. – *Automate programabile. Proiectare. Aplicatii*, Editura MatrixRom, Bucureşti, 2004.
3. Paraschiv, N. – *Echipamente numerice pentru conducerea proceselor*, Editura MatrixRom, Bucureşti, 2002.

Controlul de la distanță al unităților de pompare

Rezumat

Obiectivul lucrării constă în realizarea unui sistem inteligent pentru controlul şi supravegherea unităților de pompare bazat pe utilizarea tehnicii digitale, a rețelelor de date fixe şi mobile şi a protocoalelor TCP/IP si GPRS.
Autorii îşi propun realizarea echipamentelor locale de comandă şi control ale unităților de pompare şi conectarea acestora în cadrul unui sistem flexibil şi modern, utilizând cele mai noi tehnologii hardware şi software. Parametrii monitorizați vor fi astfel prelucrați încât să asigure o protecție superioară a unităților de pompare şi informații optime referitoare la starea acestora. Sistemul de comunicare va permite controlul şi supravegherea on-line, centralizată, a unui număr practic nelimitat de unități de pompare. Echipamentele locale vor fi conectate, în funcție de condițiile specifice, prin intermediul cablului de rețea sau prin modemuri GSM/GPRS. Funcțiile de supraveghere şi control de la distanță vor fi disponibile pe sisteme de calcul fixe sau mobile.