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USING PLCs FOR SUPERVISING LARGE DAMS

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ABSTRACT:

Programmable logic controllers (PLC) are designed for data acquisition and control, but using PLCs for supervising dams is not a very ordinary task.

Data acquisition systems for dams collect analog data from several hundreds of transducers at a very slow acquisition rate.

Because PLCs have limited number of analog inputs, you can and must use analog multiplexers to connect a very large number of traducers to the PLC steel be cost-effective.

Transducers used in dam's supervision are not the usual types of industrial transducers because they must be very reliable and because they were placed in the dam a long time ago when the dam was build. Therefor PLCs has no appropriate analog inputs for measuring them. To measure this kind of transducers you must use special interfaces to fit the transducers with the PLC.

KEYWORDS

Data acquisition, PLC, large dams supervision, vibrating cord.

INTRODUCTION

To ensure the safety of large dams, they have hundreds of build-in monitoring instruments for critical parameters such as pressure, deformation, displacement, and inclination, ground settlement, rock movements and load.

The collection and analysis of large quantities of data, especially over long distances, requires centralized and automated measuring techniques. Results are more accurate and data can be processed more rapidly, thus enabling efficient alarm system to be implemented when predetermined thresholds are exceeds. It is practically impossible to consider the instrumentation of a major dam without automated data acquisition systems.

An automated data acquisition and processing systems for the continuous supervision of a large dam is a distributed system structured on three levels:

- Local level or acquisition station - located in the dam.
- Data acquisition level - located somewhere nearby the dam. It is connected to the local level through a serial RS485 network.

Ø Central or processing level- located at distance from the dam connected to the data acquisition level through telephone, GSM, or radio transmission devices.

The local level makes the actual measurement of the whole network of transducers located in the dam.

Due to their rugged construction and their communication, facilities PLCs may be use in the local level of the automated data acquisition and processing systems.

Data acquisition systems for dams are collecting analog data from several hundreds of transducers at a very slow acquisition rate.

Because PLCs have limited number of analog inputs, it is necessary to use analog multiplexers to connect a very large number of traducers to the PLC. Slow acquisition rate allows utilization of large multiplexion rate up to hundreds to one made with relays.

Using relays also has other advantages:

- Small cross-talk between measuring channels
- High isolation of open channels
- Very low on channel resistance.

The data acquisition station for dams made with the PLC must provide the measurement for the following type of transducers frequently used in dam supervision:

- RTD –resistive temperature detectors
- resistive half bridge transducers (potentiometric transducers)
- transducers with standard current and voltage outputs
- vibrating cord instruments
- Special induction instruments (TELEMAC).

PLCs have special analog inputs for the usual industrial transducers like RTDs, potentiometric transducers and standardized output transducers.

Some of the transducers used in dam supervision are not the usual types of industrial transducers because they must be very reliable and because they were placed in the dam a long time ago. Therefor PLCs has no appropriate analog inputs for measuring them. To measure this kind of transducers you must use special interfaces to fit the transducers with the PLC.

By using some measuring interfaces, you can activate the vibrating cord and the special (TELEMAC) induction transducers make them to provide frequency signals.

The measurement of frequency signals is a very easy task for a PLC.

- Resistive, unified signal. The station has a modular and expandable structure. The modules of the equipment are placed on a plastic box with IP 65, configurable at the install in according with connected transducers number and types.

The structure of our the data acquisition station for dams called SAAD01 / S is based on:

Ø Central processing unit based on the PLC S7 Siemens equipped for resistance and frequency measurements.
Ø Adapter modules for the specific transducers, like: vibrating cord, inductive.
Ø Power supply module with battery backup

Ø Analog multiplexer modules with high reliability relays

Technical features for the SAAD 01 / S

It can be configured for each dam condition to be supervised and the customer's request. The number of multiplex blocks must be in accordance with the number of the transducers of the dam. (Max. 256 analog measurement channels).

The main measurement features are:

- Ø measurement of RTD transducers, with the compensation of connection wires resistance (3 or 4 wire method) :
  - measurement range: 0 … 150Ω
  - accuracy : ± 0.1% FS (±0.15Ω)
- Ø measurement of the half bridge transducers :
  - measurement range: 0,9 … 1,1
  - accuracy : ± 0.0005
- Ø measurement of standard current:
  - measurement range: 4 … 20mA
  - accuracy : ± 0.1% FS
- Ø measurement of standard voltage :
  - measurement range: 0 … 10V
  - accuracy : ± 0.1% FS
- Ø measurement of the special inductive transducers :
  - measurement range: 10000 ….20000 Hz
  - accuracy : ± 2Hz
- Ø measurement of the vibrating cord:
  - measurement range: 400 - 1100 Hz
  - accuracy : ± 0.5Hz

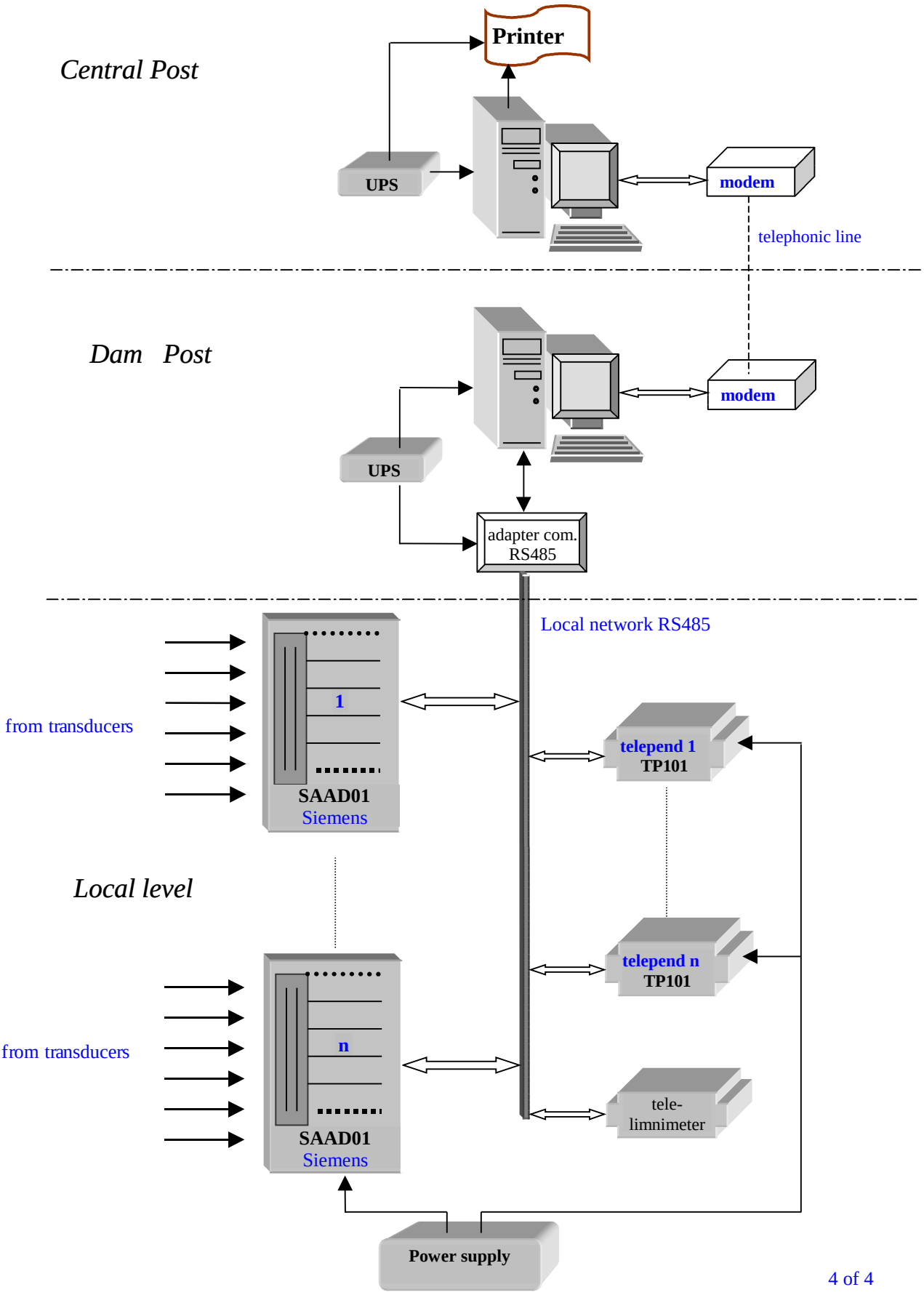
Other features

- Ø Acquisition rate max. 5 s
- Ø power supply : 24 Vdc or
  220 Vac +20%, -10%, 50Hz ± 2Hz
- Ø maximum consumption : 1,5 A
- Ø 1.5Km communication distance.

SAAD01 / S allows the manual switching of multiplexer channels to provide calibrating measurements of the transducers with portable devices. This is an important facility, because you can periodically verify the accuracy of the station measurement.

Bibliography:

1. Siemens – Component for totally Integrated Automation – Catalog ST 70 - 2001
2. Statie automata de achizitie date UCC la baraje – SC IPA SA Filiala Cluj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