MODULAR, INTELLIGENT AND DISTRIBUTED SYSTEM TO CONTROL WATER TREATMENT PLANTS

A. Menéndez[1-2-4], D. Martin[2-4], D. F. Larios[1-3] and E. Personal[1-3]

[1]Department of Electronic Technology, Escuela Politécnica Superior, University of Seville
[2]Member of IEA Research Group (Instrumentation in Electronics and Applications), University of Seville
[3]Member of Electronic Technology and Industrial Informatics Research Group, University of Seville
[4]Technological Center ProDTI Foundation

amenen@us.es, dmartinreina@gmail.com, dflarios@dte.us.es, epersonal@us.es

ABSTRACT

There are many examples of small villages which are provided with quality problems in the potable water supply. The treatments to resolve the above mentioned problems are hard tied to the types of pollutants in the water. This demands the development of custom-made facilities with a maintenance that needs specialised labour. Both things mean an increase of the facilities cost. The consequences of this are that either these works are not carried out, or that its maintenance is neglected.

In view to resolve these problems the IEA Research Group of the University of Seville takes several years developing water treatment systems especially designed for small urban populations. To do this, a modular control system has been developed that allows high adaptation flexibility to the specific needs of each population, without raising the deployment cost. It offers a robust design, guaranteeing that it will run even in isolated rural environments, where the appearance of electrical perturbations is usual. All this, along with an intelligent management, allows an autonomous working without needing to do any expensive maintenance.

CONTROL SYSTEM

This distributed control is based on a master element (PLC) which communicates by means of a bus with various slave modules, each of which is associated with specific tasks of the process.

Each distributed electronic module is in charge of the local control of the part of the process with which it is associated, so that the element of top hierarchy is only entrusted with coordinating the global functioning of each of the processes.


Example of slave module

Communication Bus

An originality of our design lies in the use of a new fieldbus. It is called MBus-I/O®. An outstanding feature of this fieldbus is its aptitude to power the modules across its own bus cable ($24V_{dc}$ and $24V_{ac}$).

This feature is not typical in other standard fieldbuses due to problems of EMI. As a solution to this, the MBus-I/O® presents a structure with multiple ground wires with specific functions that increase significantly the robustness of the system. All this is obtained using a economic UTP standard cable.

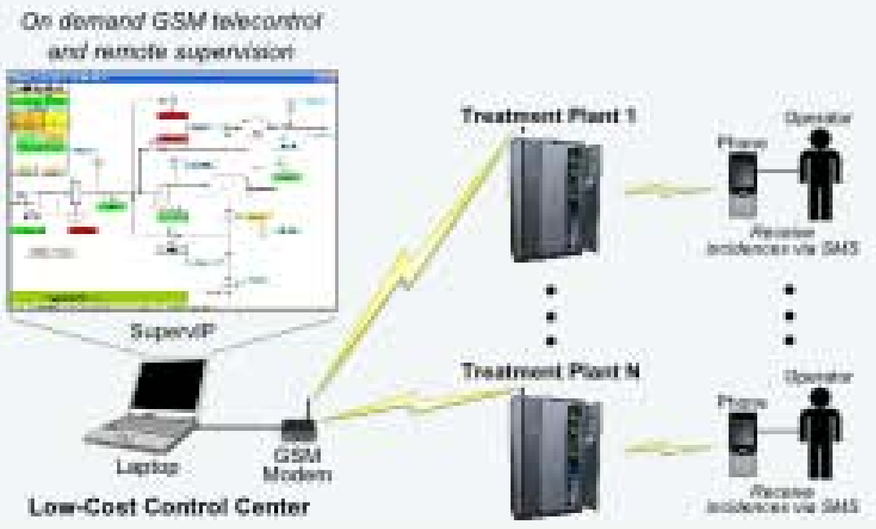
Distributed modules

Each electronic slave module is based on a powerful microcontroller and realizes specific tasks like the valve position control, dosage control, flow measurements, human-machine interaction (HMI), etc...

This philosophy, joined to a system of plug & work connection, makes these modules very easy to install or to substitute in case of breakdown, without specialised labour being necessary. This allows the costs to be minimized compared to the use of existing commercial devices.

Remote control

This remote supervision can be done with a GSM/GPRS connection by means of an SCADA application that allows to known the state of the plant and also to detect any functioning anomaly. As well, it has been programmed with a SMS mobile courier service, which informs the person in charge of the plant instantaneously when detecting an anomaly, facilitating an effective and economic maintenance.



RESULTS AND DISCUSSION

Main advantages:

- Max. simplication and wiring saving for **minimun installation cost**.
- Max. **flexibility "Plug & Play"** for I/O elements including electric powering.
- Max. **inmunity** against electric disturbances for stand alone operation.
- Max. distributed "intelligence" for automatic in situ **fault-detection**.
- Max. mainteance facilities with an easy **remote control** and **home calls** for minimun cost.

This technology has been successfully used for the development of several industrial water desalination plants prototypes with capacities from 10 up to 400 m^3/day.

The last ones developed, with registered trademark CIBERDESAL®, are being used by the Junta de Andalucia to resolve the problems of quality of the drinkable water that have some small populations of Andalusia due to the presence of salt and nitrates in the wells that supply them.

These plants have worked in an uninterrupted and autonomous way since their installation in a noisy environment, despite the shortcomings in the electrical supply, including atmospheric discharges, as to the own conductivity of the water that facilitates the transmission of the perturbations on the diverse inputs / outputs of the system.

The use of the new MBus-I/O® has been a key element by its immunity to electrical perturbations (according to IEC 61000-4-4). All this has demonstrated that the proposed system is not only economic to install and support, but also it turns out to be very robust, being therefore a suitable solution to answer the needs of small populations.

CONCLUSIONS

In this work, a system of modular, intelligent and distributed control has been proposed that allows a high grade of flexibility, with both low installation and maintenance costs.

As well its capacity of auto-detection of anomalies, along with the remote control system capable of warning a worker automatically by SMS, means that the proposed solution turns out to be especially indicated to resolve the problems of water treatment that are endured in small villages with difficult access.

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