

AN APPLICATION FOR GENERATING OF SYNOPTICAL CONTROL PROCESSES

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Abstract. The work present an application for generating general programs control process. The URSIN-V2 is a New Application for Generating of Synoptical Control Applications of Industrial Processes

Keywords: *Control, synoptic.*

The URSIN-V2 is a new version of URSIN, an original generator of industrial processes applications.

Regarding the synoptical control of industrial processes we must consider: signal transmissions, noises and their correction, data collection and selection necessary for control, the synoptical control object, the insignificant or incorrect signal selection, screen synoptic.

The industrial processes, data are usually collected through electrical signal, from position translators in different points (generally critical point, or "hot" points). This signals are transmitted to far enough distance, therefore there is danger that signals to become altered, this alterations increasing by distance and cables position on other appliance, that can induce interference in cables. This interference is also called noises and they are most important chapter in measuring technical, that study methods and possibilities for noises removal or compensation (the noises correction and filtration). The data collection and selection necessary for control is generally made hierarchical way beginning from local production post, then to department level, etc, coming to activity synoptic.

We specify the synoptical control object:

- **the creation of global synthetic image, about the process progress;**
- **the control of correlations and influences for different process areas;**
- **the taking of operative decisions for checking products quality and quantity in different types and sizes (assort-type-sizes);**
- **the control of accurate operation for equipment and outfits, together with centralized diagnosis of technological malfunction;**
- **the control of power and materials consumptions, etc.**

Unfortunately, the synoptical controls are made for distinct production lines, and only is very few case for complex industrial processes. Anyway, where there is classical synoptic control (using synoptic automation panel), the computer control can be easily

introduced, using the centralization of ready existing signal and date. For instance a synoptic representing a compressors station or one calcinations station, although they are form funcțional point of view absolute different industrial processes, the synoptical control problem is identical.

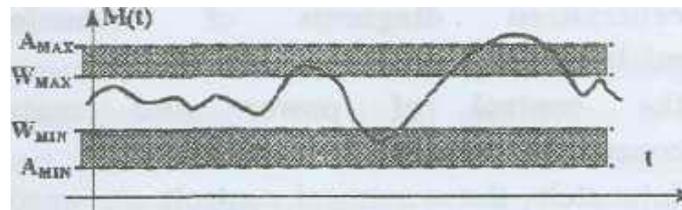
We don't pretend we offer the best solution, being convinced our solution is perfectible, in this work we presents the practical realization of my work conceiving in [JOLD93] and extended it in other our works.

We define the synoptic point as the image in the synoptic spaces for control a controlled point in the industrial process. A synoptic contains at least one synoptic point. The synoptic point is therefore the primary element that contribute to the achievement of synoptic A synoptic point is defined by its coordinates (x,y) and its case that numerical value of the followed parameter is written in.

The sizes that will be displayed by different precision, specified by the beneficiary. These could represent physical parameters: temperature, pressure, voltage, current, flow capacity, speed, displacement, time, caliber, tolerance, number of resolution, on/off position, etc.

The physical size that is represented is represented in synoptic point can have aleatory variation. In the synoptic point will be displayed the instant value of the automatically read size for certain well defined time period, hi order to respect certain manufacture receipts and realize some adequate quality values in most cases the sizes have to be situated in certain values domain. The domain included between the minimum warn threshold (bigger that minimum alarm threshold) and the maximum warn threshold (smaller than the maximum threshold) has to be smaller than admitted values domain.

If we note A_{MAX} = maximum alarm value, A_{MIN} = minimum alarm value, W_{MAX} = max warn value, and W_{MIN} = minimum warn value, then between these value it has to exist the following relation: $A_{MAX} > W_{MAX} > W_{MIN} > A_{MIN}$.



If the instant value $M(t) \in (W_{MIN}, W_{MAX})$ we have a normal operation because the followed parameter is in the admitted value domain. If $M(t) \in (A_{MIN}, W_{MIN}]$ or $M(t) \in [W_{MAX}, A_{MAX})$ we will be in the warning domain when the operation is in the normality limit and it has to be taken all necessary measures to bring back on the parameter in the admitted values domain (through technical measures taken attempting personnel). For the rest of operation is abnormal and measures that the attempting personnel have to take, are emergency measures for damage conditions with all responsibilities due to these conditions. In the control process beside these analogical variation size, the binary sizes can appear and all of those are treated by the achieved

system. Generally in technological flows there are interconditionings (interblocking) between the consisting equipments. This matter imposes to take into considerations every technological flow that will be controlled on a synoptical panel, to ensure all logical chains and interconditionings necessary to a proper operation. For proper treating is necessary to ensure the observance of the validation conditions for different explored variables as well the interconditionings occur between different equipments. The value of the explored variables in the control process have to be framed in the admitted variation domain, this being done through the control — variable by variable - of the framing between the initially imposed minimum and maximum value. This imposes a circular exploration of measuring and control physical points to be for exactly defined period. After each exploration is automatically checked the framing within the limits. In case that some values come out of admitted domain start is necessary signalization and alert. It is know that most of followed sizes have a slow variation in time in practical activity. More important variations are generally produced in case of same damages that can occur in the current evolution of the industrial process, this idea suggest us possibility of controlling by computer of the increasing and decreasing gradient for each followed parameter. Of course having a computer we can afford to calculate the variation gradient for that size in comparison with last reading and in this way we can compare them with the alarm and alert limit gradient set by the beneficiary. The gradient can be reported to the circular scanning quantum of the parameters or to the time unit. The validation conditions can be verified through standard procedural methods or using adequate mathematical filters.

Concerning the interconditionings problem we have to consider that these are absolutely necessary because:

- **the turning on or off for some equipments has to done in a certain succession;**
- **to turning off of an equipment can endanger the operation of other equipments upstream or downstream in the technological flow belongs;**
- **some equipments have a greater importance in the technological flows, they represented what it is know as leading equipment;**
- **some equipments that work defectively can produced explosions, fires, and other misfunctions;**
- **some equipments combination can work parallel or others don't have a technological sense;**

The variables that take part in interconditionings relations are generally binary variables ('relay' type). Therefore the interconditionings conditions can be checked by the implementation of some neuronal networks (feedforward).

Every synoptic has a graphic image that must be displayed on the display. The graphic image can be built up of one or more monitor displays (Then it can be divided into more subsynoptics - disjunctive on of another- that can be displayed entirely on the monitor display, and their reunion can represents the entire synoptic). Each subsynoptic will be displayed on the whole, monitor display and its graphical image can be stored in a graphical file that we call screen file. To create a global image of the whole synoptic there will be scanned circularly all screen files (all subsynoptics) with a certain time period set by the person who uses it (as it will be shown in the URMA program presentation). The graphic image of subsynoptic can be created with any graphical editor

and saved in PCX format, or captured image in the same format. This artifices offers us possibility to control the industrial processes for departments, workshops, sectors, etc. some of them heaving absolute distinct technologies or activity objects.

Supposing we have already captured the screen we want to work wide (obtained in the first stage), let's turn them into account. These graphical files will be used in the second stage, the files generating of URSIN-V2 applications. This generation is made by the GENE program.

The **GENE** program ensures the screen files that contain the measuring synoptical points, the competences files and hierarchical diagnosis file generation, as well the simulation of the neuronal network for the validation of the interconditioning and diagnosis conditions. This program has a pop-up type menu that provider the quick access to all program functions. The program menu consists of the following submenus:

- The **ECRANE** (SCEENS) submenu provides the generation of the screen files (with specified name and extension) starting from the contains the image capture. The following data are requested for each synoptic point: the synoptic point code, the synoptic point identifier (an identifier that will appear on the synoptic in the screen box, before the read value in process), the co-ordinates X and Y of the synoptic point (these co-ordinates represents the pixel co-ordinates in the upper left corner of the box where will be displayed the identifier and the read value in the process corresponding to the synoptic point), the unit measure, the type of the read size (A = analogical, B = binary), the scale factor of the read value, the color (for the box, frame and writing) the priority to incident of the synoptic point, if is or isn't an inhibit synoptic point. For the case when the read size is an analogical size there are supplementary requested the whole numbers and decimal that the size will be displayed in the screen box, the maximum and the minimum alarm value, the maximum and minimum warning value, and the maximum and minimum gradient. For the case when the read size is binary one there are supplementary requested the synoptic points that are in a center block with the present synoptic point (the screen number, the synoptic point number of the respective screen and if it coexist or not with that point). The **LISTARE** (LIST) and **VIZUALIZARE** (VIEW) options can make listing and displaying of the generated screen files that contains of all synoptical points. These files will be used for the actual displaying of the values URMA control program.

- The **COMPONENTE** (COMPONENTS) submenu contains two options: **GENERARE** (GENERATE) and **LISTARE** (LIST). The GENERARE option provides the generation components files when must be introduced: the name, function, competence, access password and competence degree of every personnel that takes part in a way or an other to the development of the controlled production process. A single files is generated for all screens controlled through the URMA control program.

- The **DIAGNOZA** (DIAGNOSES) submenu has the options: **GENERARE** (GENERATE), **REȚEA NEURONALA** (NEURONAL NETWORK) and **LISTARE** (LIST). The GENERARE options provides the generation of a single diagnosis file on the hierarchical system of competences. Therefore is requested the introduction in the keyboard of screen number, the synoptic point number on the screen and the present point diagnosis for the warning or alarm case. The **REȚEANEURONALA** option provides

the training (learning) of the neuronal network with forward reaction that has maximum 10 hidden layers. This neuronal network are used for the control of the interconditioning condition sand hierarchical diagnosis, in URMA program. The LISTARE option provides make a listing with diagnosis file on the hierarchical system of competences.

- The **IEŞIRE** (EXIT) provides the output from programming WINDOWS, NORTON COMMANDER or DOS.

After the end of the GENE program execution all application files are created and we can proceed to next implementation and execution stage. As we have already shown this stage can be executed on the fly, without to disturb the production process, only connecting in the connector strings of the control panel, the inputs of the data acquisition system. Here **we must take care that the connection order to the acquisition system to correspond width the read order declared to screen file generation** (ECRANE submenu, GENERARE option) in order to exit a perfect compatibility between the reading order and synoptic point position an the monitor display.

The program that provides control of the industrial process is called **URMA**. This program consults through GENE program all generated files that provide all configuration elements of the real control application required by beneficiary. The program URMA reading periodically, the reading period being imposed beneficiary, the readings are made through the serial port that is connected to acquisition system.

The **URMA** program accepts commands from the personnel who used it and transmits attention, warning, al arm or error messages necessary to operating personal for quick intervention to salve the issued problems. On the basis of the instructions and messages, the URMA program create the CONSOLOR file where it is historically kept the situation of all instructions and messages, in order to be allow the control of the component instructions. **The CONSOLOR file a sort of 'black box' of the entire controlled process** (a record, of this file contains all necessary identification information). When is needed this file can be daily saved and listed in order to have of the 24 hour activity development **this thing having a very important part in the observance of the technical-function discipline.**

The URSEV-V2 application can be used not only for the synoptical control of the industrial processes, but this application can be used for railway traffic, aerial traffic, surveillance and guard, etc.

The URMA program allows the permanent synoptical control of industrial process. This program uses all information from files (files generated through the GENE program) and offer the possibility to work in three modes:

- **REAL** - the work mode in real time (default);
- **COMM** - the work mode of command waiting;
- **TEST** - the work mode of test.

The work mode **COMM** allows executed different commands which were supplied by human operator, simultaneous match with control industrial process. This work mode activated with F5 or ESC key. The URMA program recognized and executed the following commands:

- **BE** = the circular spooling of screen;

- **EC** = displaying an only screen defined by human operator;
- **PD** = print the incident's diagnosis;
- **ED** = displayed the incident's diagnosis;
- **II** = the train interaction;
- **PI** = print the diagnostic file;
- **CO** = competence of operator (is necessary: name, function, password, etc);
- **PC** = print the CONSOLOR file;
- **SP** = print the synoptical point's status;
- **GR** = displayed the graphic of evolution for last 50-th readings of synoptical point defined by operator;
- **TP** = change read period for data through serial port;
- **PO** = inhibition to start/stop process;
- **CT** = continuation control (after the start process);
- **TM** = ended of program URMA.

All aspect connected to the instruction and messages that appear in the control development are compulsory in the CONSOLOR file.

The **TEST** working conditions is generated the dynamic file FDIN in normal domains for controlled size and simulated just a single value beyond limits, from 5 to 5 reading teaching in this interactive way the operating personnel.

In **REAL** working conditions is made the proper control of the industrial process. Under these conditions it is accomplished periodic reading through serial port of the offered data by the acquisition system being generated the dynamic file FDIN where always are held 50 last readings in the industrial process. In an incident (namely when the warning or alarm limits are over fulfilled or interconditioning conflict) sound signalizations an light blinking are made and they persist until the incident is solved. The operator can extract the necessary diagnosis for the incident case and deliver them to responsible personnel in order to solve the incident.

The source of URSIN-VI application will be available free by e-mail; rjoldes@uab.ro as soon as the present work will be published.

REFERENCES

- [1] RJoldes, E.Olteanu — *Considerații privind generarea automata a aplicațiilor pentru urmărirea sinoptica a proceselor economice si industriale*, in voi. INGINERIA PROGRAMĂRII* INFORMATICA APLICATA, Editura ASE București - România, 1993, pp.39-43.
- [2] RJoldes - *The URSIN-VI Application for Generating of Synoptical Control Applications of Industrial Processe*, in voi. SOFTWARE ENGINEERING AND APPLICATIONS, ASE Printing House Bucharest, România, 1995, pp.489-494.
- [3] RJoldes - *URMĂRIREA SINOPTICA A PROCESELOR INDUSTRIALE * ABORDARE INFORMATICA*, Editura RISOPRINT Cluj-Napoca, România, 2000, ISBN

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