

## High-level program environment intended for operations with technological objects in P-net network

Authors:

O.I. Moukhine Dr.Sc.

A.A. Shelemekhov Dipl-Ing

V.A. Noskov Dipl-Ing

### The problem

The P-net system is easy to work with because of its modular principle of construction. It turned out that the assembly of this system the Hardware level needs a minimum of time and efforts. A controlling system designer spares his main time for creating the Software level. This level is necessary to control the technological object direct from the computer. And it should be done in terms the operator usually uses. Thus the efficiency of the complex system construction depends on the following facts:

1. Ability to construct the system using the modular principle on the Hardware – and Software level as well.
2. Ability to observe the current technological process
3. Provision with the high – speeded system creation, which could correspond to the assembly time of the P-net

### Task and object

As an example let us construct a simple system of the liquid heating, using P-net. The sensor and the heater, connected to the controller PD 3221 UPI, are immersed in the liquid. The controller is aimed to support the temperature given. In case the temperature level is lower, than one stated in the Y1 level, the heater is switched on. If the temperature level is higher, than one stated in the Y2 level the heater is accordingly turned off.

Model of the system

First, the system was made in Stratum 2000 environment. In order to do this the project with the description of 4 objects was created. These objects are a vessel with liquid, a sensor, a heater and a controller.

The model of the vessel containing liquid is represented as

$$dQ := (T_e - T_w) * k_c * dt + dQ_h$$

$$Q := Q + dQ$$

$$T_w := T_w + dQ / (m * c),$$

Where

$Q_h$  – the heat, supplied from the heater for time quantum

$Q$  – the general quantity, received by the vessel with liquid

$K_c$  - coefficient of the heat transfer

$T_e$  - the temperature of the environment

$T_w$  – liquid temperature

$M$  Liquid mass

$C$  – specific capacity – 4190 J/kg\*k

The heater model  $dQ_h := K * work$

The sensor model  $t := t_w$

The controller model

If(work)

$work := (T_w < (T_{const} + \delta))$

Else

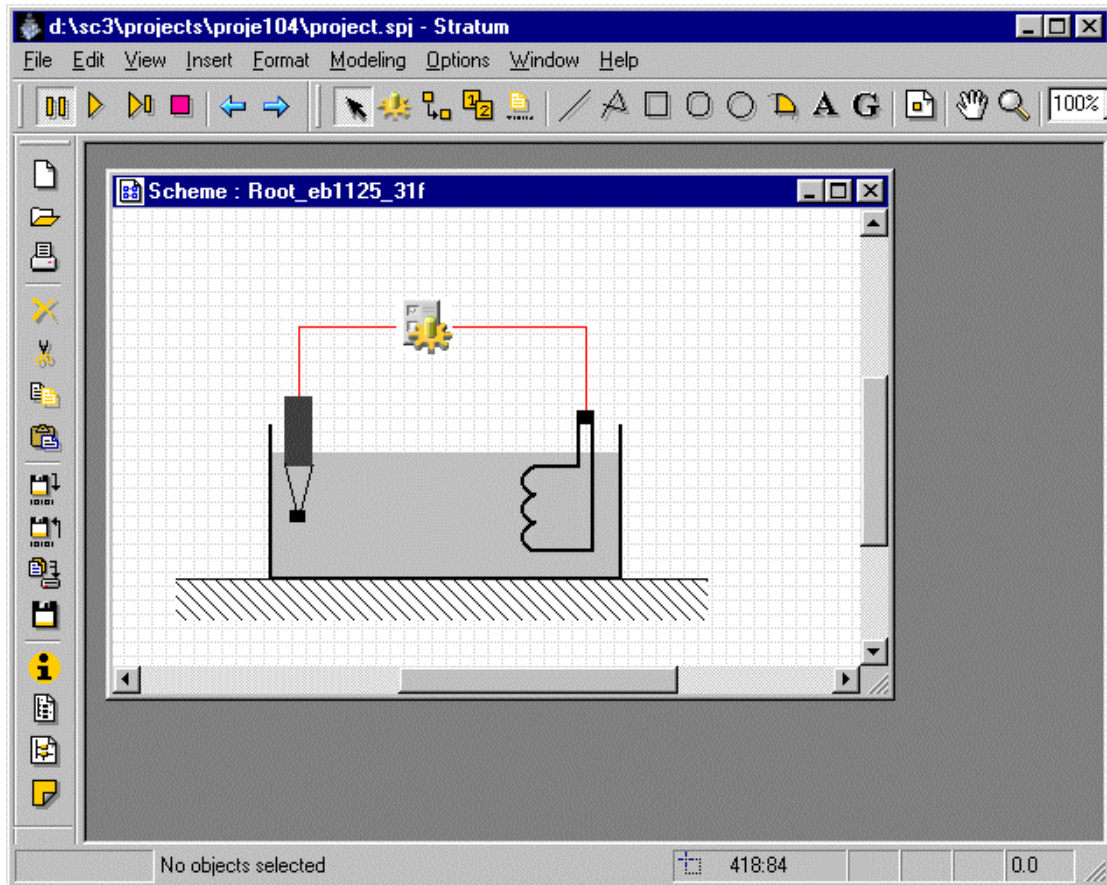
$work := (T_w < T_{const})$

endif

where  $T_{const}$  – Y1level,

$T_{const} + \delta$  – Y2 level.

When constructing the system in Stratum 2000 environment we will get the following scheme:

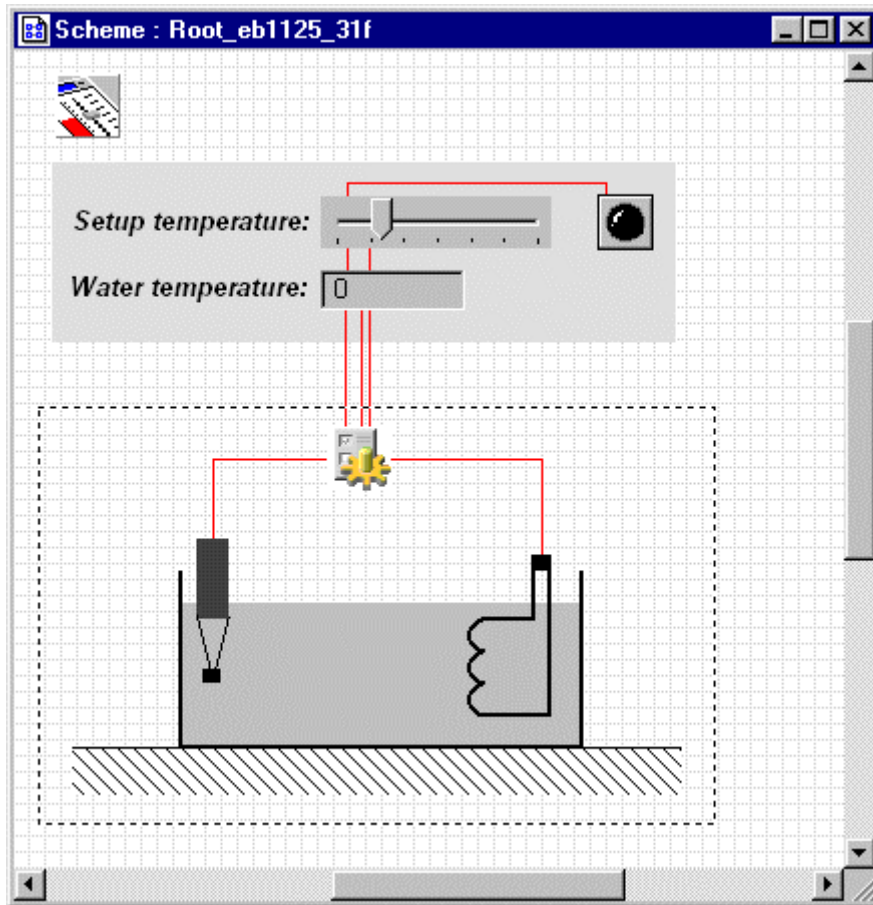


Pic. 1. The model of complex controlling system in STRATUM 2000 (variant 1).

Set the initial values in order to start the work of the scheme and then to study its work. As a result, the designer can be convinced in the correct work of the future scheme.

The control panel

Let us add the control panel to the system. This panel is necessary for the operator to observe the object state and to set levels. You need just to draw the panel and to set the standard objects. The objects in their turn allow us to set the variables values by moving the mouse and to represent them in digital format.

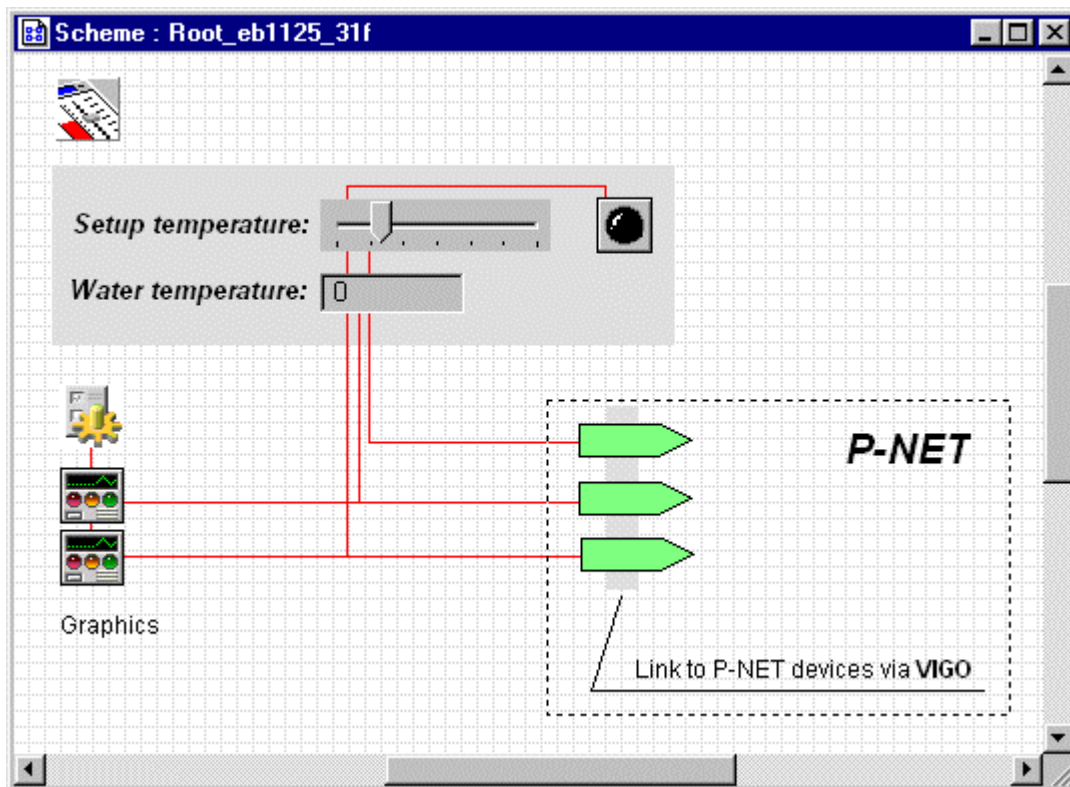


Pic. 2. The system model with the control panel (variant 2).

### Connecting with the equipment

After the system model was test-operated and stated by the Customer the real plant assembly is followed.

P-NET Interface Module PD3221 UPI was used, the sensor and the heater were connected. But the task was to control it with the help of the computer and the control panel just drawn. The links between the control panel and the control unit objects were transferred to the objects getting the P-NET system access. Realization of these linking objects can be represented as direct addressing to the driver or as the reading of the OLE-variables by the co-work with VIGO. But we have confined to work with the OLE-protocol.



Pic. 3. The system model with objects of links with P-NET equipment (variant 3).

### The profit

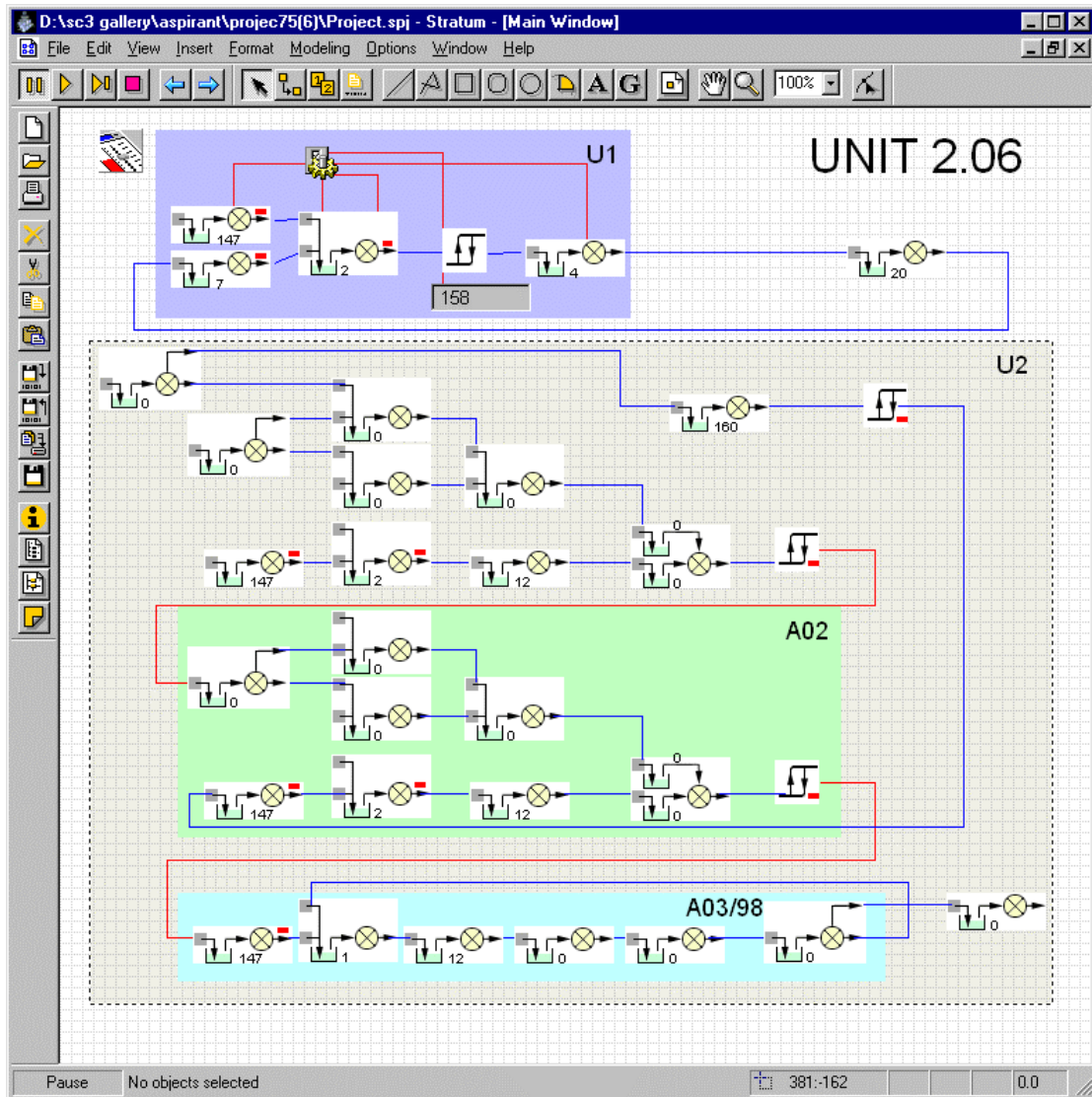
All work took 4 hours. The documentation was carried out with the help of **Stratum 2000** system. The 2nd variant of this system after connecting of the expert system set became the service staff simulator. The design, modeling and control environment **Stratum 2000** provides:

- fast creation of models and complex separated production control systems;
- comfort of the design and the future control network simulation with the modeling resources;
- technological object control in the real time with the environment connection to P-NET equipment.

The program works in Windows 95/98/NT environment, takes 10 Mb in the disc and needs IBM PC Pentium 166/16 Mb. The P-Net equipment connection allows us create the production controlling system both with the central desk and network of workplaces with computers, control the technological process from the PC in the real time remotely. P-NET system and Stratum 2000 provide the efficient and high-quality complex problem solving.

The Stratum 2000 system was used for pollution monitoring in the town up to 100,000 inhabitants (11 posts), observing the moving objects state (200 vehicles, 7 measured parameters), conveyer belt control (100 operations an hour), 3D ultra-sound scanning of nuclear station pipe-line condition, dwelling unit communication monitoring and control.

The example of realization is shown on picture 4.



Pic. 4. Example of the real time model and controlling the complex production system.