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INFORMATION PROVIDING AND SOFTWARE OF CONTROL SYSTEM IN GREENHOUSE WITH NEURAL NETWORK PREDICTIONS OF EXTERNAL DISTURBANCES

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Annotation. *Information providing and software for automated control system in greenhouse was developed. Neural network predictions of external disturbances were analyzed and were added as unit into control system architecture.*

Key words: ***information, database, greenhouse, neural network, control system.***

The feature of modern automated process control systems and production is the use of large amounts of information, which is used in real time for instant decision making and control of the system and for statistical analysis and data processing and the development of new strategies for the system.

Algorithms for selecting control strategies become increasingly complex, and therefore for their implementation is significantly greater amounts of information. On the other hand, for monitoring the system needed comprehensive information, analyzing and statistically by computing the conclusions that can work on the system as a whole [2].

Purpose of research – development of information database model, diagrams and data flow of control system for biotechnical objects.

Material and methods. Many studies about greenhouse environment control systems have been based on the concepts of energy and mass balance and physical modeling. But the practical realizations of these concepts are difficult and expensive. This work exploits other method for creation control system which based on neural network and also takes into consideration biological particularities of plants. Greenhouse, which was researched as biotechnical object is situated in Brovary district Kyiv region called Public Company “Combinat “Teplichniy”. Based on the statistical data obtained through information-measuring system and current information on performance of tomato static characteristic of the object was acquired [3].

Having taken into account the research the process control diagram of growing plants in the greenhouse was developed (Fig. 1).

The modern level of computer integrated technologies allows building automated control systems unlimited number of technological processes and industries. Computers that are separate objects are integrated into the network. In this case, each of the objects is both data provider to the overall space information systems and consumers of this information.

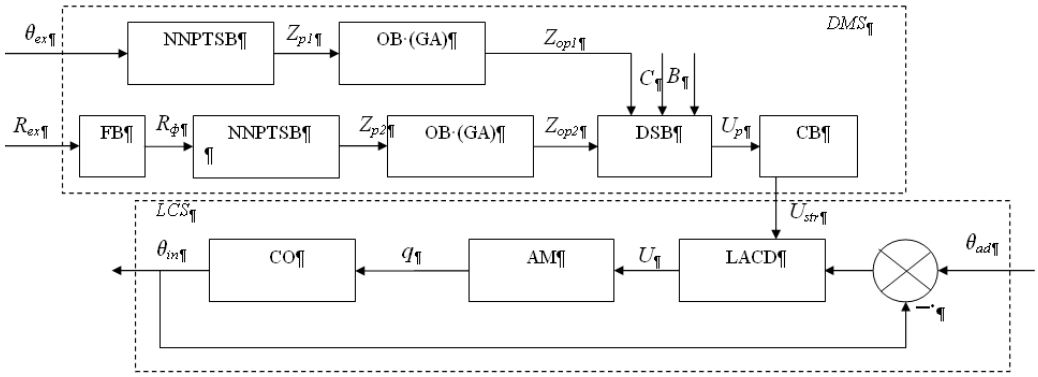

Fig. 1. Block diagram of the process control system in the greenhouse: DMS – decision making subsystem ; FB – filtration block for solar radiation intensity; NNPTSB – neural network predictions for time series; OB(GA) –optimization block with genetic algorithm; DSB – decision making block; CO – control block; LCS – local control system; LACD – local automated control device; AM – actuating mechanism; CO – control object

Results and Discussion. Information-measuring system (IMS) for recording and monitoring such environmental parameters, as solar radiation intensity and outside air temperature, was placed in PC "Combinat “Teplichniy” (Fig. 2).

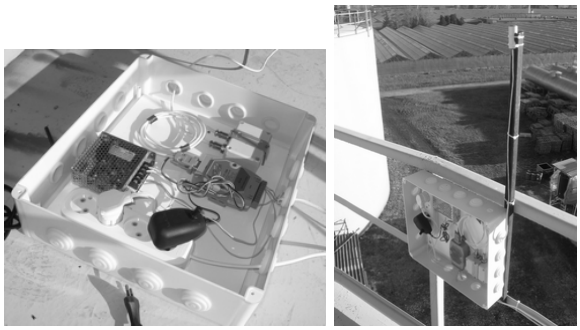

Fig. 2. Information-measuring system of external disturbances

With a view to develop the information structures of the control system for biotechnical objects the problem area and all tasks which have to be solved were analyzed in detail [4]. The main system units and data connections between them were allocated (Fig. 3).

Tables that contain all necessary information were formed using the relational database model:

- Sensor
- Actuator
- Command
- Error
- Measurement
- Measurand
- Price

Entity SENSOR contains information about all sensors and counters available in biotechnical system; ACTUATOR – about actuators: COMMAND – an entity that contains a list of commands that are sent by the computer or controller to actuators, ERROR – table of errors which could arise during operation of automated control system. This information allows to signal the operator about error in time, and further analyze the control system in general with the aim of improvement. MEASUREMENT is an entity which contains measurements of all variables that are important for biotechnical object (temperature, humidity, water and electricity costs, etc.); MEASURAND – list of the variables which are measured by monitoring subsystem; PRICE – important information, that is used by control system to calculate the most effective control decisions.

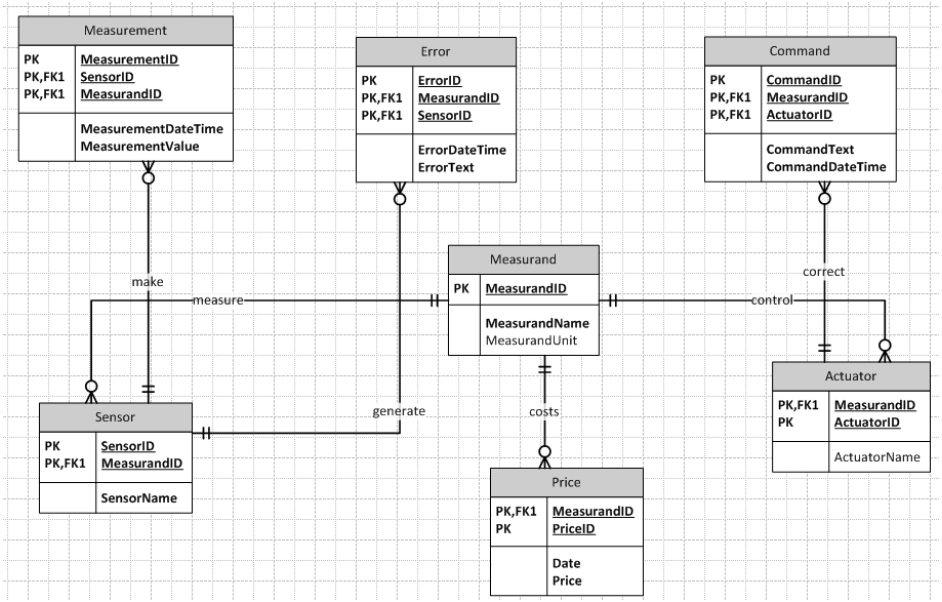

Fig. 3. Information structure of decision making subsystem

In this table are recorded current prices for resources (energy, water, feed, fertilizers, etc.), ensuring consideration of economic feasibility of produced control solutions. Information from this table can be used both by an operator and by automated control system to calculate control criterion for effective control decisions based on the criterion of profit.

Control system software for monitoring the external influences and technological microclimate parameters in a greenhouse was developed using modern IT methods and tools. Also getting weather forecast using Internet is implemented (Fig. 4).

In order to transfer the measured parameters from the local computer installed in a greenhouse, to the computer, which is in the laboratories of the department, was developed special software (Fig. 5). Using the Internet allowed to transmit information in real time.

These enabled the processing of measured parameters statistically and use the database of greenhouse microclimate for training the neural network.

Based on the type of neural network multilayer perceptron received external disturbances predictive value (solar radiation intensity and air temperature [1]).

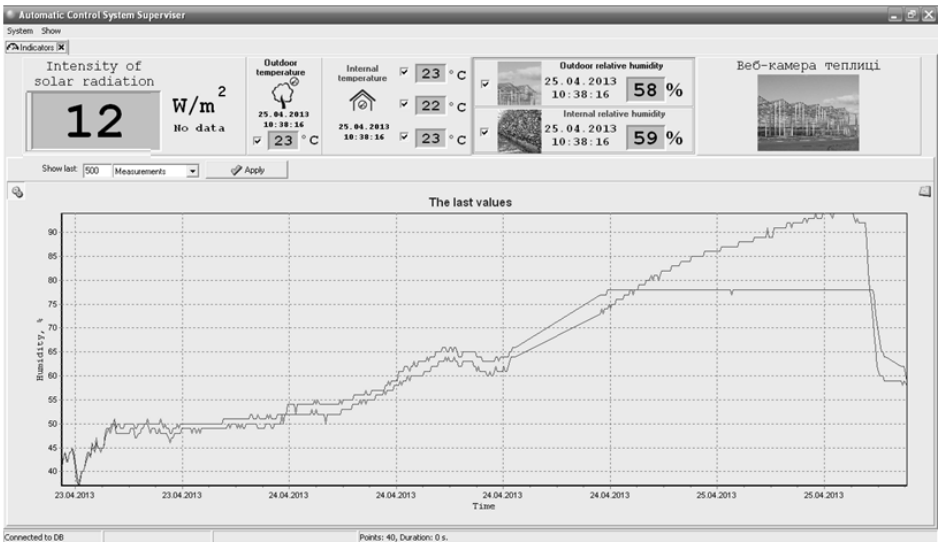

Fig. 4. Control system interface

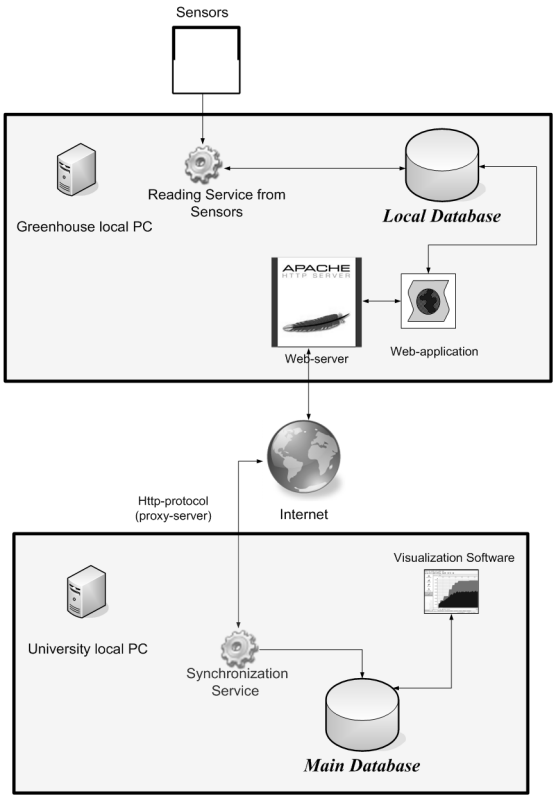

Fig. 5. Structure scheme of data transfer via Internet

Conclusions

1. Complex research allowed to establish the list of factors that affect the tomatoes productivity, to single out external natural disturbances and biological characteristics of tomato as being insufficiently studied and not taken into account in decision making control actions.

2. Information providing and database were used to save measured microclimate parameters in the greenhouse. Special software that allowed transferring data in real time was developed.

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ІНФОРМАЦІЙНЕ ТА ПРОГРАМНЕ ЗАБЕЗПЕЧЕННЯ СИСТЕМИ КЕРУВАННЯ У ТЕПЛИЦІ З НЕЙРОМЕРЕЖЕВИМ ПРОГНОЗУВАННЯМ ЗОВНІШНІХ ЗБУРЕНЬ

А. Дудник

Анотація. *Розроблено інформаційне та програмне забезпечення системи керування у теплиці. Проаналізовано блок нейромережевого прогнозування й створено базу даних та інтерфейс користувача для системи керування у теплиці.*

Ключові слова: ***інформація, база даних, теплиця, нейронна мережа, система керування.***

ИНФОРМАЦИОННОЕ И ПРОГРАММНОЕ ОБЕСПЕЧЕНИЕ СИСТЕМЫ УПРАВЛЕНИЯ В ТЕПЛИЦЕ С НЕЙРОСЕТЕВЫМ ПРОГНОЗИРОВАНИЕМ ВНЕШНИХ ВОЗМУЩЕНИЙ

А. Дудник

Аннотация. *Разработано информационное и программное обеспечение системы управления в теплице. Проанализирован блок нейросетевого прогнозирования и создана база данных и интерфейс пользователя для системы управления в теплице.*

Ключевые слова: ***информация, база данных, теплица, нейронная сеть, система управления.***