

INTELLIGENT SYSTEM AND EQUIPMENT FOR GREENHOUSES MONITORING

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Abstract

Greenhouses are one of the interesting and important parts of agriculture. Industrial greenhouses are used for growing of large amount of vegetables, fruits and flowers. Individual greenhouses usually have small sizes and are used as hobby of people for growing different, sometimes exotic plants. For correct growing of plants is necessary to ensure special conditions as soil moisture, room lightening, soil, air temperature, and so on. In the case of industry greenhouses, the monitoring process usually is provided by a control system and operator, who regulates necessary conditions. In the case of individual greenhouse usually is difficult to obtain required growing conditions due to impossibility for individual person to be always next to the greenhouse. For solving of this problem can be used network system and special equipment, placed into the greenhouse.

Proposed greenhouse represents a modular system, which consists of separate planters that are essentially links of one whole chain. Planter is equipped by all necessary components for ensuring required growing conditions. Main of them are heating, watering, and lightening systems. On the bottom of planter a heating cable is installed so that it does not disturb the water drainage. Excessive moisture simply flows out from the planter along inclined floor. Soil watering is done by nozzles placed on the front and back walls of the planter. Both ends of watering tubes can be joined to general watering system by threaded components. Plants lightening is made by lamp places in the planter top. Required light intensity can be ensured by different lamp types. Planter local electrical and watering systems can be simplicity joined to local systems of other planters and to greenhouse system as a whole. Separate planters usually are used for growing of defined types of plants. Generally, all necessary parameters can be controlled by monitoring system but some of them will be obtained by planter controller and some by greenhouse controller. Air temperature and moisture covers larger space than area of one separate planter and should be monitored by greenhouse measuring system. Soil electro-conductivity and acidity do not change abruptly and intensely and can be measured twice in the season by portative devices. Main parameters, light intensity, soil moisture and temperature are measured by sensors installed into planter. Measuring frequency can be some seconds and even milliseconds but for plants growing process it is not necessary to measure these parameters more often than once an hour or once a half of hour.

Main component of communication system is a global cloud server where a constantly updated database is held, which contains parameters of growing conditions and recommendations. Greenhouses and planters have IP addresses and can be separated in the global system. Planter controller periodically measures plant lightening, soil moisture and temperature by installed sensors. Greenhouse controller reads this information from all planters into the greenhouse and also measures air temperature and moisture by sensors. Server periodically reads this information from all greenhouses in the cluster, compares with required values and if it will be some deviations from norm sends a command to the greenhouse controller. The user (greenhouse owner) is able to receive the current state of all necessary parameters from the server by smartphone. In addition, he is able to change default values of growing conditions for its own greenhouse or separate planters.

Main result of this research is creation of a global monitoring system. Database is created on base of fifteen types of plants and can be flexible expanded. System proposes to customer information about validated planter and conditions for its good growing. For online monitoring server periodically communicates with greenhouse microcontroller. Costumer can get information by SMS or 4G connections.

Key words: *Vegetables, Fruits, Plants, Greenhouse, Monitoring.*