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DESIGN OF GREENHOUSES IN A MODERN SCADA SYSTEM

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Abstract
The purpose of this study is to design a smart green home system to help the process of vegetable growth in urban areas by utilizing SCADA and IoT technology. This system can help planting vegetables in urban areas with natural conditions that are not possible and limited land. Using the hydroponic planting method will certainly be very appropriate because it does not need soil as its growing medium. The system that we designed can control and monitor parameters that affect the development of vegetables such as temperature, humidity, nutrition, water level, light, and water use in real time.

Keywords: General information about SCADA, SCADA technology, operation process of SCADA in greenhouses, calculation of economic efficiency indicators, data analysis of air circulation, humidity control, SCADA energy efficiency.

Introduction

Greenhouse cultivation plays a very important role in modern agriculture. Since the greenhouse is usually equipped with various high-tech equipment, the management is very complicated. Fully automated greenhouse management systems provide obvious benefits such as labor savings, but more importantly, they allow for improved product quality and data collection that can make the difference between making a profit or a big loss[1].

Introduction The increasing lifestyle of people in urban areas and eating patterns that are classified as instant can make public health in urban areas less attention. The emergence of health problems may be due to unhealthy eating patterns and mostly consume foods that are instant and practical. This is where the need for a healthy lifestyle and self-awareness to maintain a balanced food intake. With the start of a healthy lifestyle awareness in the community and awareness of healthy foods such as vegetables, it will increase the consumption needs of vegetables in the community so that the supply must always be maintained and always stay fresh. Therefore, the supply must be balanced with a large and fast vegetable production. However, on the other hand it is almost impossible to plant vegetables in urban areas because in addition to natural conditions and land is an obstacle[2]. Therefore we need an artificial ecosystem that can resemble the real nature. With artificial ecosystem technology, growing vegetables can now be applied on limited land such as in urban areas, so that it becomes more efficient. Green house technology can bridge the needs of vegetables in urban areas through a hydroponic planting system that does not require planting media such as soil and without pesticides. This hydroponic system will produce healthy vegetable products without chemicals such as pesticides and no seasonality in the planting process, so that people in urban areas will be able to get fresh vegetables for consumption every day. Utilization of green houses in urban areas will be very efficient because it is not fixated on certain ecosystems. The availability of fresh and healthy vegetables on the market will continue to be maintained. To maintain the quality and the quality of the greenhouse production of this hydroponic system in its production requires precise data, is controlled quickly, and can be monitored directly so that the production process can produce good products[3]. This requires a system that can control and monitor data directly on the green house. IoT smart greenhouse monitoring and control solution enables remote and automatic care of the crop inside the greenhouse. The solution uses climate, irrigation, nutrient application, temperature, humidity and lighting management systems to ensure the healthiest and highest quality crops.

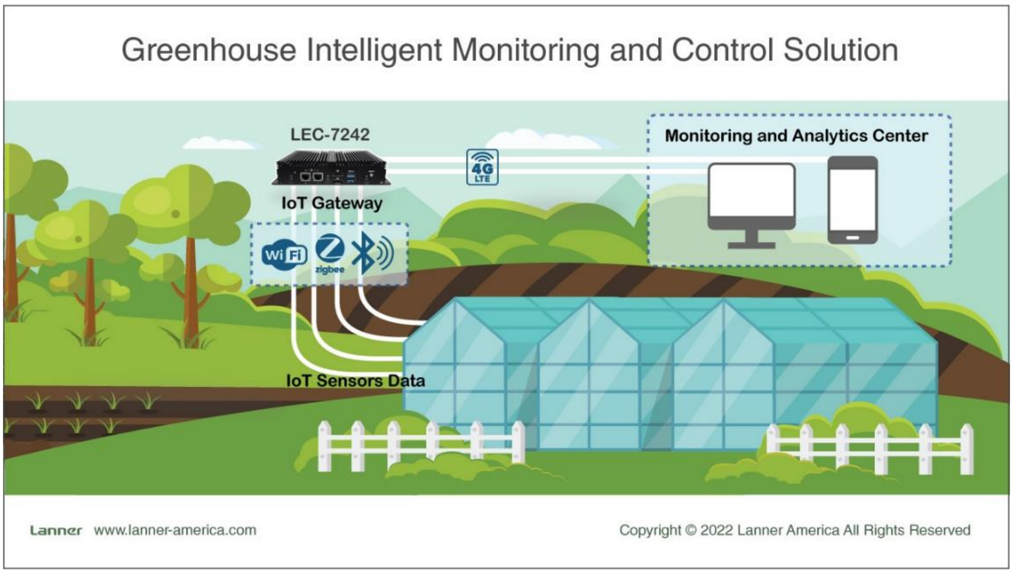

Figure-1.Essential elements of a smart greenhouse monitoring and control solution.

Methods

Methods The design of the smart greenhouse system is carried out with several stages and several preparation processes, so that the system can be structured and made easier in the design process. The initial stages of the design method are divided into 3 parts, namely RTU greenhouse A and B databases, data communication systems, and monitoring parameters for plant development of smart greenhouse systems. In 2 units of greenhouse RTU, they communicate with SCADA CIMON with Modbus RTU RS-485 communication media which only uses 2 wire cables, namely A and B[4]. In principle, the data communication system to these 2 RTU units communicates in sequence, starting from slaveID 1 then slaveID 2, where in this communication process each address variable sends or receives data sequentially starting from the 40001-40045 address. By using Team Viewer software, it is possible to communicate data with the smart greenhouse system remotely using a computer/laptop and can also communicate this data using a mobile phone[5].

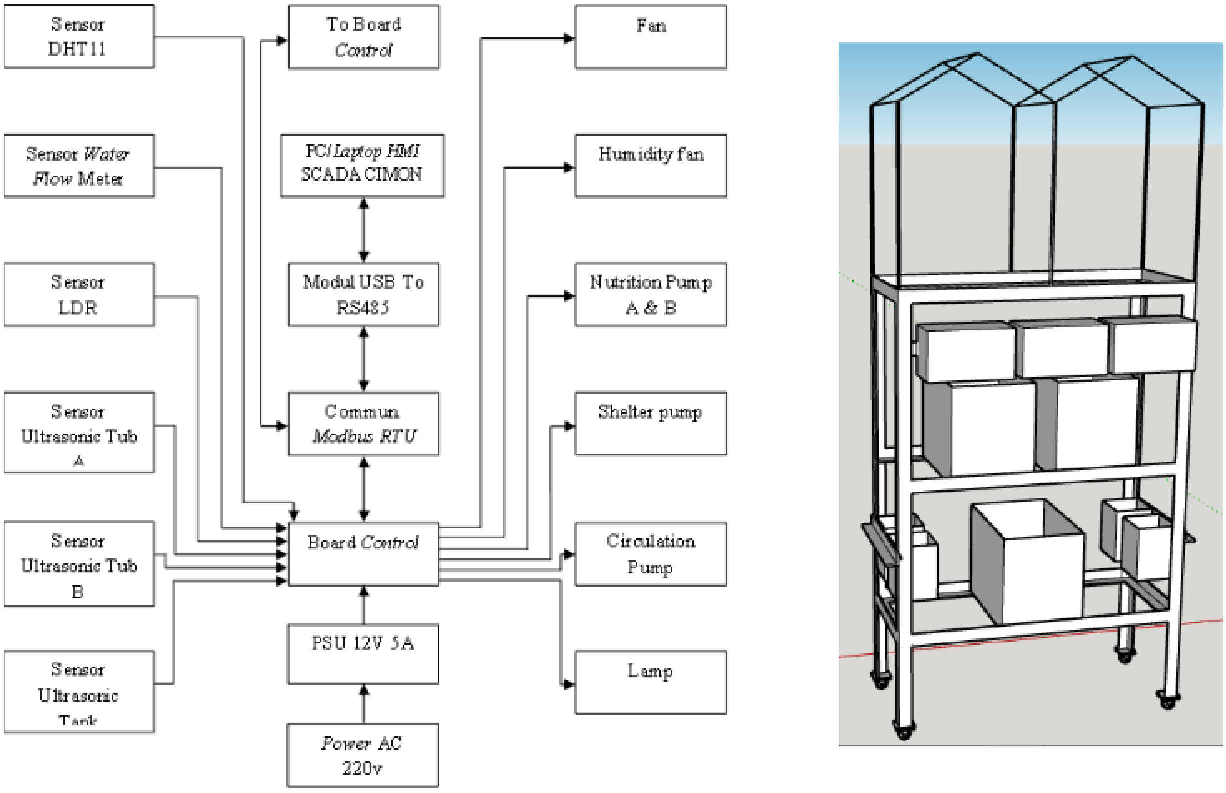

Figure 1. Diagram block and prototype of Smart Green House.

A smart greenhouse solution uses indoor IoT sensors or meters to collect Ph, humidity, humidity, temperature, photometric, electrochemical, water, energy, CO2 and photosynthesis data. The solution can also use outdoor environmental IoT sensors that measure sunlight, wind direction and temperature. Other data sources can also be obtained from external weather feeds. The solution also consists of actuators that influence changes in the indoor microclimate through irrigation, fans, shading networks, fluid flow control or heating/cooling[6].

An IoT gateway integrates data from all IoT sensors, pre-processes them and provides communication to a cloud-based monitoring system. An intelligent IoT gateway provides capabilities such as pre-processing (compression, deduplication, encryption, de-redundancy, etc.) of all IoT collected data to optimize data storage and reduce network latency. The IoT gateway also provides rich I/O for connecting sensors, meters, displays, PoE-powered devices, and external drives. Other important components of the Greenhouse IoT Gateway are its robust wireless support and rugged design that can withstand harsh environmental conditions for IT equipment in greenhouse deployments [7].

Greenhouse IoT sensors are connected to Lanner's LEC-7242 Industrial IoT Gateway via WiFi or LTE. The LEC-7242 is an industrial wireless gateway powered by an Intel® Apollo Lake CPU and certified by FCC/CE/PTCRB for LTE or WiFi. The device is designed for IoT/IIoT edge and wireless security. The device is built using advanced fanless passive cooling

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technology, so it can operate in a wide range of 0°C ~50°C/-20°C~70°C and relative humidity 5%~95% (non-existent). condensed) environments - ideal for greenhouses[8].

Monitoring and Maintenance

Control circuit and simulation software The circuit was designed with the help of simulation software for electrical circuits such as Proteus 8. The Arduino microcontroller was used to control the entire system[9].

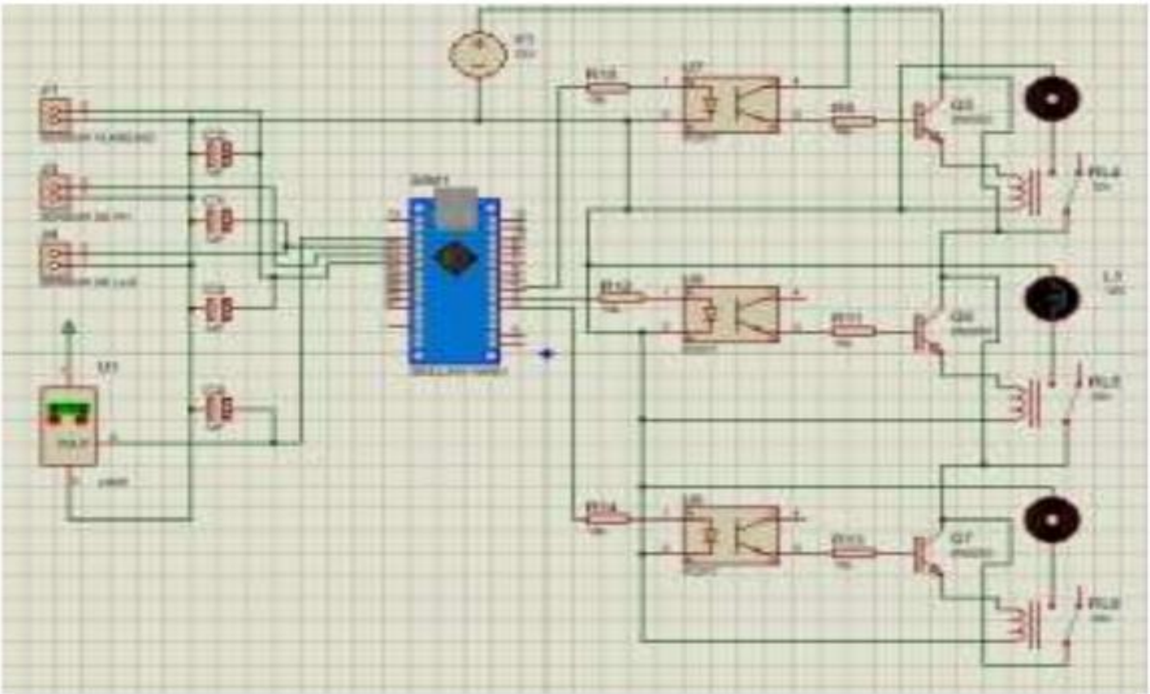

Figure-9 Control circuit, the power part is isolated from the sensors

The power circuit was separated from the control circuit as it is shown in figure 9, the main source is 12V and relays are used to activate the actuators because they consume more current than the Arduino supplies. A 2N2222 transistor is used to drive the relay, and an optocoupler is used to isolate the power circuit from the control circuit[10].

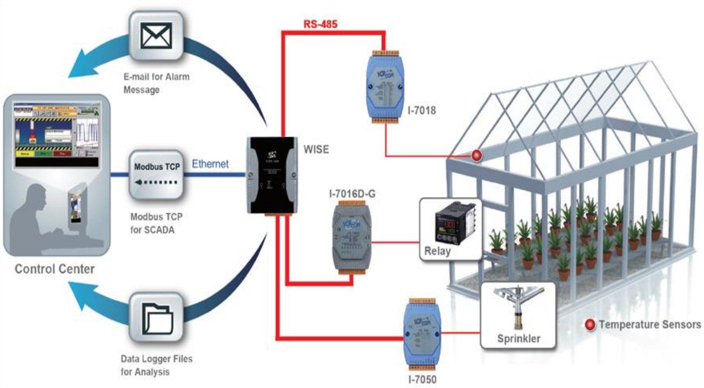

Figure-1. SCADA system management

WISE allows connection to various I/O modules for thermocouple inputs that allow real-time monitoring of temperature and humidity in the greenhouse; The DO module can be connected to various greenhouse structures. It determines the state of the greenhouse in real time and in response to connected sensors; the control system automatically adjusts fan position, fans, heating, mist, shade, lighting, irrigation frequency, irrigation nutrient level and CO2 level, etc[11]. The WISE controller continuously monitors key environmental factors affecting crop quality and makes continuous adjustments. the manufacturer cannot achieve the same level of consistency. In addition, the WISE controller also supports Modbus and IoT protocols so that data can be instantly transmitted to the control center, making the real-time monitoring of the overall status of each greenhouse more efficient.

Programming and Calibration:

Programmable Logic Controller (PLC) : A PLC is a special computer system that performs control functions in a SCADA system. It is responsible for monitoring and controlling various devices and processes based on commands from sensors and operators or inputs from the control system. A PLC executes pre-programmed logic instructions to make decisions and initiate control actions. PLCs are designed to be robust, reliable and capable of operating in industrial environments. They are programmable, allowing flexibility and customization to meet specific control requirements. PLCs can interface with a wide variety of devices, such as motors, valves, switches, and relays, allowing industrial process control and automation[12].

A combination of HMI, RTU and PLC forms the basis of a SCADA system. The HMI provides an interface for operators to interact with the system, the RTU facilitates data collection and communication, and the PLC performs control functions based on received data and commands. Together, these components enable effective monitoring, control and automation of industrial processes, leading to increased efficiency, operational efficiency and overall efficiency[13].

Conclusion

In the past generation greenhouses it was enough to have one cabled measurement point in the middle to provide the information to the greenhouse automation system. The system itself was usually simple without opportunities to control locally heating, lights, ventilation or some other activity, which was affecting the greenhouse interior climate. The optimal greenhouse climate and soil adjustment can enable us to improve productivity and to achieve remarkable energy savings. In this paper we proposed a multi-agent methodology for integrated management systems in greenhouses. In this regards wireless sensor networks play a vital role to monitor greenhouse and environment parameters. Each controlled process of the greenhouse environment is modeled as an autonomous agent with its own inputs, its own outputs and its own interactions with the other agents. Each agent acts autonomously, as it knows a priori the desired environmental set-points. In this way, any possible conflicting decisions of conventional environmental control methodologies are resolved through negotiations between the agents so that the possible optimal integrated solution is achieved. The developed system is simple, cost effective, and easily installable

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