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Remote Greenhouse Monitoring Road Map

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Close and continuous tracking and adjustment of environmental elements are the keys to successful greenhouse cultivation. However, manual checks and adjustments prove to be labor-intensive and impractical, particularly in larger operations.

Therefore, it's important to install an automated monitoring system. Using cloud-based technology, these systems empower greenhouse staff to remotely monitor the environmental conditions of their greenhouses at any time. They can also evaluate how effectively fans and pumps are maintaining these conditions.

Remote monitoring systems operate around the clock to provide continuous surveillance. They help identify falling or rising temperatures; ventilation problems; heater, fan or other equipment malfunctions; high CO₂ levels; humidity changes; soil moisture levels; frozen or ruptured irrigation lines; water leaks and power failures.



While a remote monitoring system cannot prevent unforeseen disasters, it can promptly notify greenhouse operators of environmental changes that threaten plant inventory and property. When conditions deviate from preset parameters, the system immediately alerts workers through calls, texts or emails.

These systems offer advantages to greenhouse facilities of all sizes. However, with a plethora of options and features to choose from, selecting the appropriate remote monitoring system can be a daunting task. Here are key considerations to bear in mind during the evaluation process.

Identify Specific Needs

Each monitored condition requires a dedicated sensor input on the base unit. Basic, low-cost, non-expandable systems may suffice for smaller sites, while larger facilities with a larger workforce benefit from multi-unit systems that can monitor numerous points. In cases where the operation anticipates growth, opting for an expandable system can enhance the value of the initial purchase, eliminating the need to replace the entire system as the business expands.

When evaluating the specific monitoring needs of a greenhouse operation, consider the following:

- Communications access—cellular, Wi-Fi, ethernet, landline phone
- Types and number of conditions to monitor
- Data logging and report generation
- Number of people to be alerted
- How to receive notifications—phone call, text, email
- Hardwired or wireless sensors
- Basic versus expandable system

In addition, note the details about the scope and purpose of the greenhouse operation. Important factors include:

- Structure of the greenhouse (metal, plastic, wood)
- Covering material (glass or plastic)
- Number of greenhouse structures
- Floor space square footage and height of each greenhouse
- Outdoor climate
- Space and microclimate dedicated to specific plants
- Types of lighting, ventilation and irrigation system
- Level of technological automation versus manual operation

Having an internal rechargeable battery backup is crucial. This ensures monitoring and alerts continue without interruption during power outages. Additionally, it is advisable to place the base unit in an enclosure to safeguard it from common greenhouse elements such as moisture, dirt and chemicals.

Select and Place Necessary Sensors

Selecting sensors depends upon the conditions to be monitored and how many sensors can connect to the base unit. Of course, monitoring temperature is critical, but there are many other factors to keep tabs on as well, such as humidity, CO₂, soil moisture, water pH, power and equipment failure, ventilation and physical security.



Humidity

Sensors are required to detect changes in humidity levels in greenhouse environments. High humidity fosters harmful fungi, mold and mildew growth. Conversely, low humidity can lead to water loss, causing plants to wilt.

In addition, high humidity levels can impede transpiration. When the air is saturated, it becomes more difficult for plants to release water and absorb nutrients from the soil, hindering growth.

High humidity also affects plant photosynthesis by influencing the behavior of stomata—small openings on the surface of plant leaves. Closed stomata can restrict the plant's intake of carbon dioxide (CO₂), a crucial component for photosynthesis, impacting plant development and productivity.

Carbon Dioxide

The ideal level of CO₂ in a greenhouse depends on the type of plants, the environmental conditions and desired growth

rates. Typically, plants grow better with CO₂ concentrations ranging from 800 to 1200 parts per million (ppm), which is approximately two to three times the natural level of CO₂ in the atmosphere. It is crucial to avoid CO₂ levels above 1500 ppm, as this can be toxic to plants. Using sensors in the greenhouse allows staff to monitor and adjust CO₂ levels effectively to maintain them within the ideal range.

Soil Moisture

Because excessively wet or dry soil stresses or kills plants, monitoring soil moisture levels is vital to the long-term health of plants. Top of Form

Soil moisture sensors measure the volumetric water content in soil and other growing media and trigger an alert when moisture conditions fall outside the desired range. This instant notification prevents over- or under-watering, minimizes water usage, promotes growth and increases crop yield and quality.

Water pH

Maintaining the correct pH level prevents nutrient deficiencies from excessively acidic or alkaline water. Select a monitoring system equipped with a pH sensor that can be installed into the water supply pipe to sample water as it flows through.

Power Supply

Certainly, a continuous electrical supply is essential to keep vital greenhouse equipment operating, including lights, water pumps, irrigation lines, heaters, ventilation fans, louvers, humidifiers and dehumidifiers. An electrical outage monitoring sensor identifies power interruptions and can also help to detect potential equipment issues such as power fluctuations.

Ventilation

An exhaust system helps control the temperature and humidity while preventing the invasion of mold and pests that thrive in hot, moist, stagnant air. Automatic ventilation systems include vented roofs, side vents and forced fans that run on electricity. Temperature and humidity sensors reveal when these factors rise, indicating a problem with air circulation equipment. Vibration sensors can also be used to indicate vibration fluctuation on equipment such as fans. Anomalies in vibrations, often caused by unbalanced mechanisms or faulty bearings, can serve as early warnings for potential malfunctions.

Greenhouse Security

Regardless of the size or location of the greenhouse operation, an intruder can be a threat to plants and profits. Remote monitoring systems, integrated with door and window magnetic reed switches and infrared motion detection sensors, offer a sense of security. These systems promptly notify personnel of any unwanted presence in the greenhouse, enabling swift response to potential threats.

Consider Connectivity Options

Most remote monitoring devices are inexpensive compared with greenhouse control systems. And they offer scalability, ranging from simple monitoring of a few points to extensive coverage of thousands of points. Certain remote monitoring devices can integrate with control systems, retrieving and remotely presenting the data. This enables users to observe their control system's status from off-site and set alarms on existing systems.

The majority of remote monitoring systems use an internet or Wi-Fi connection, although landline phone-based systems are available. In cases where an internet connection is not available, a cellular system is a viable option, with a few caveats. First, verify adequate cellular signal strength at the site and assess signal quality in the area. In instances of weak cellular coverage, installing an external antenna can enhance the signal. Next, you need to register on a wireless network.

Some systems require hardwiring the sensors to the monitoring device. The sensors can be placed up to 1,000 feet away from the base unit. Alternatively, wireless systems can be used in situations where hardwiring sensors poses logistical challenges. These systems use integrated radio transmitters to communicate with the base unit. Other monitoring systems accommodate a combination of both hardwired and wireless sensors.

Access Sensor Readings and Receive Notification Alerts

Cloud-based monitoring systems enable users to access real-time status and historical data for all monitored greenhouse conditions via a dedicated web page, mobile app or phone call. Upon detecting a change in status, these monitoring systems immediately dispatch alerts to all individuals listed in the contact directory.

Setting up multiple notification methods (phone, email and text) provides extra assurance that personnel will see the alert. Make sure the system can accommodate the number of people that must be notified and can automatically cycle through the contact list until someone responds.

Log Sensor Data

Historical sensor data can help identify patterns and trends in greenhouse conditions. However, manually monitoring and recording these parameters demand a substantial amount of personnel time, diverting attention from other essential workplace responsibilities.

Cloud-based monitoring systems offer the advantage of automatically storing an unlimited number of data points, dates and times. Analyzing this data can provide important insights into larger issues, enabling proactive measures to prevent problems before they emerge. For instance, regular power fluctuations recorded in the data log might indicate a more serious problem. Similarly, if vibration sensor data reveals signs of a ventilation fan malfunction, it allows for timely repairs or replacement before a complete failure occurs.

Calculate Return on Investment

Remote monitoring systems can be a significant investment. When determining how much to spend, calculate the comprehensive cost, including installation, additional peripherals and sensors. Take into account the value of your plant inventory and greenhouse equipment. Additionally, consider the potential cost of downtime should an incident temporarily halt your operation.

Add Up the Considerations

Every second counts when it comes to maintaining plant health. The sooner a problem is discovered in a greenhouse, the more inventory you can save by taking preventive action. That's why it is important to ensure continuous monitoring of key greenhouse conditions.

The right remote monitoring system for your greenhouse will depend on your specific needs. What works best for one greenhouse may not work best for another. Make sure you choose the best system for your greenhouse by considering all the factors above.

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