Research on greenhouse switchgear system using RFID chip

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Abstract— ***In order to grow crops in smart farms, appropriate temperature and humidity are adjusted according to growth conditions, and careful management is required. To this end, external air circulation and internal temperature and humidity control should be performed by opening and closing the vinyl greenhouse window. However, RFID chips are currently intended to be used to solve the problem of switch malfunctions that manage temperature and humidity due to extreme high temperatures and sensor operation errors. Unlike the existing automatic switch control system, the tag is expected to solve the problem of switch malfunction by identifying in more detail whether the curtain switch of the vinyl house is fully opened and closed through RFID chips.***

Keywords—*RFID, Switch, Temperature aand humidity, Smart Farm*

I. INTRODUCTION

Growing facilities, such as greenhouses and greenhouses, are constructed of materials that effectively transmit light for efficient crop production. In these facilities, strong sunlight can penetrate and cause internal temperatures to rise to 30°C or higher [1]. When temperatures get too high, farm operators either open windows to bring in fresh air from the outside or use ventilation to keep the high temperatures inside in check. In particular, temperature and humidity switchgear is widely used to automatically regulate temperature and humidity to ensure that crops maintain an optimal growing environment [2].

However, these switchgear systems are currently experiencing malfunctions due to extreme high temperatures, repetitive window opening and closing motions, sensor malfunctions, etc. This increases the likelihood of crop damage, and it is important to periodically check the operation of the switchgear in order to prevent and respond proactively [3]. However, if damage occurs due to poor system operation or inexperienced operation by the farmer, the likelihood of disputes with the farmer increases. To solve these problems and increase the stability of farm operations, it is necessary to develop a system that can quickly check the operation of switchgear.

This paper approaches this problem from two main directions. First, we aim to track the status of the switchgear in real time by embedding RFID chips in the opening and closing sections of the switchgear. Second, the system detects signals from these RFID chips to identify whether the switchgear is operating normally, and if a malfunction is detected, we aim to build a warning and response system. This allows farmers to easily check the operating status of the switchgear, and it is expected that the system can be automated to quickly respond to possible problems.

This paper details the design and implementation of a switchgear motion detection system through RFID chips, and discusses the expected effects and application possibilities. Finally, in the conclusion of the paper, it is expected that such a system will improve the efficiency of agricultural production and contribute to crop protection, and furthermore, suggestions will be made on the direction of technological development suitable for the future agricultural environment.

II. INTRODUCTION

A. *System phrases for providing layouts*

There are well-defined design criteria for disaster resistance in horticulture and specialty crop facilities, and greenhouses are sized accordingly for disaster-resistant crops. There are various models of greenhouses, such as semi-moon, square, tri-quarter, round, and interlocking, each of which has its own thickness and dimensions [4].

To cope with these different house models, RFID chips are embedded in the top and bottom positions of each model so that the opener can accurately detect the top position of maximum opening and the bottom position of maximum closing. The RFID chip consists of an IC chip and an antenna that are responsible for data input, and transmits data to a reader via wireless communication. When the switchgear is opened or closed, the RFID chip communicates wirelessly with the switchgear to determine whether it is 100% open or closed automatically.

This technological improvement not only increases the reliability of the switchgear system, but also enables consistent operation for each greenhouse model. Utilizing RFID technology, the operating status of the switchgear can be monitored in real time, helping farmers to operate and maintain efficiently. Through automatic judgment and communication, the system can quickly detect switchgear malfunctions and respond appropriately.

In this study, we provide details on the design and implementation of a switchgear system utilizing RFID chips, which is expected to improve the reliability and efficiency of agricultural production. In addition, we discuss the scalability and application of this technology as a consistent solution for different greenhouse models. Finally, we would like to conclude the paper with the positive impact of the switchgear actuation system with RFID chips on farm operations and suggestions for future technological developments.

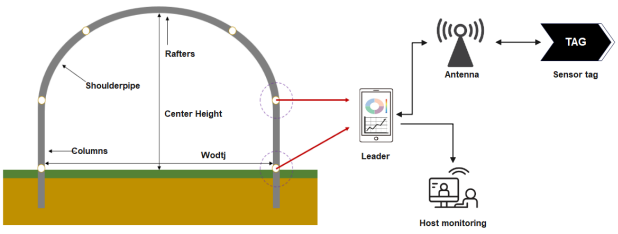

Figure 1. How RFID chips

<Figure 1> visually explains how an RFID chip works. An RFID chip consists of a sensor tag, an IC chip that handles data input, and an antenna that handles wireless communication. These chips communicate wirelessly with a reader to send and receive various information [5].

First, in the sensor tag, data collected from the environment or an object is input to the IC chip. This IC chip then communicates the collected data wirelessly to the reader system via an antenna. The reader system controls the frequency emission and decodes the data received from the sensor tag and converts it into meaningful information. This allows the various data read from the sensor tag to be monitored by the reader system.

The reader system is connected to the host system so that the data received from the sensor tags can be monitored and managed by the host in real time. This allows RFID technology to detect the state of an environment or object and relay information about it to the host system through fast and effective data communication.

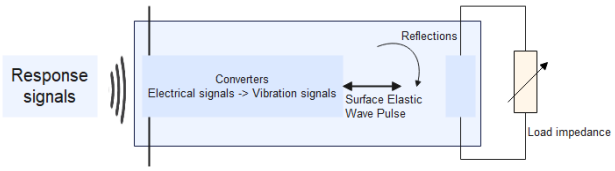

Figure 2. Configuration diagram of sensor

<Figure 2> shows a block diagram of a sensor tag. Sensor tags perform functions to measure and record environmental conditions, and by integrating them, practical and effective data collection becomes possible. It mainly consists of an active sensor tag, which contains circuitry for transmitting and receiving radio frequencies [6].

Active sensor tags use the 13.56 MHz frequency to transmit and receive frequencies wirelessly. This frequency allows the sensor tag to initiate wireless communication when it comes into contact with a reader, and allows the reader system to read the data from that sensor tag. This ability to communicate wirelessly allows the sensor tag to provide data to the reader in real-time about environmental conditions.

It is important to note, however, that if the sensor tags do not communicate with the reader even after the switchgear system is operational, there is a possibility that there is an error in the operation of the system [6]. This indicates a situation where the wireless communication between the sensor tag and the reader is not working normally, and such an error can be quickly detected to determine whether the system is operating normally or not. Therefore, this configuration of sensor tags increases the reliability of the switchgear system and enables rapid response required for farm operations.

In this paper, based on the configuration and working principle of the sensor tag described in <Figure 2>, we will

discuss the application system of a switchgear that meets the specifications of a greenhouse in an agricultural environment.

TABLE I. . SPECIFICATION OF VINYL GREENHOUSE PIPE

(mm) (od)		1.0		1.2	1.4	1.5	1.6	1.7	2.0
in	m/m	kg/m		kg/m	kg/m	kg/m	kg/m	kg/m	kg/m
5/8	15.9	0.367		0.435	0.501	0.533	0.564	-	-
3/4	19.1	0.530		0.530	0.611	0.651	0.690	-	-
7/8	22.2	0.523		0.621	0.718	0.766	0.818	-	-
1	25.4	0.602		0.716	0.829	0.884	0.939	0.994	-
1 1/8	28.6	0.681		0.811	0.939	1.00	1.07	1.13	-
1 1/4	31.8	0.760		0.906	1.05	1.12	1.19	1.26	-
1 1/2	38.1	0.915		1.09	1.27	1.35	1.44	1.53	1.78
2	50.8	-		1.47	1.71	1.82	1.94	2.06	2.41

<Table 1> shows the specifications of greenhouse pipes categorized according to various uses. In this table, the specifications of greenhouse pipes used for various uses such as material houses, gardening houses, annual plants houses, mushroom houses, ginseng houses, and various livestock and fish farms are organized [7].

In accordance with the standards set for these various applications, it is proposed to install RFID chips on the top and bottom of the greenhouse pipes. The RFID chips can then be recognized by the controller, allowing it to check in real time whether the pipes in each greenhouse are installed according to the specifications.

The installation of RFID chips not only improves the performance of the switchgear system, but also helps farm operators to manage and maintain the system efficiently by making it easy to check the compliance of greenhouse pipes with the specifications. Therefore, the installation of RFID chips and the specifications of greenhouse pipes presented in Table 1 are expected to contribute to the stable production and quality of agricultural products through technological innovation in the agricultural field.

In this paper, a study is conducted on the design and implementation of a switchgear system applying RFID technology based on the specifications in Table 1, and the effect of improving the efficiency of the agricultural production environment can be seen.

III. CONCLUSION

If farmers can detect switchgear failures and malfunctions early, they can effectively reduce maintenance costs and minimize the cost of crop damage. Through this research, it is expected to introduce a system where the RFID chip is recognized by the reader embedded in the section where the switchgear is fully opened and closed, confirming that the system is operating smoothly, and if it is not recognized, it is judged to be a malfunction and a quick response can be made through host monitoring.

In such a system, the role of the RFID chip becomes crucial. To ensure the normal operation of the switchgear, the RFID chip installed in the reader must work correctly. If the RFID chip is recognized in the section where the switchgear is fully opened and closed, it indicates that the switchgear is operating normally, and if it is not recognized, it is considered a malfunction, and the problem condition can be detected quickly.

Through these technological improvements, this thesis seeks to improve the ability of farm operators to quickly identify and respond to switchgear problems. By utilizing the host monitoring system to check the status of switchgear in real time, it is expected to contribute to maintaining productivity by quickly responding to potential problems that may occur during farming operations. Therefore, this research is expected to actively contribute to increasing the stability and efficiency of agricultural production systems.

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