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"An Intelligent supplementary lighting systemfor the Strawberry Greenhouse"

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ABSTRACT

The Temperature and lighting data of an eleven strawberry greenhouse system are detected by an intelligent supplemental lighting system. Strawberry greenhouse transfers control commands and saves, displays, analyses, and interprets the data that has been gathered. Consequently, the strawberry greenhouse's temperature control and intelligent red-blue LED combination light supplementary illumination are realized. The system aims to optimize environmental conditions within the greenhouse by dynamically controlling a heating/cooling fan based on real-time temperature data. Additionally, it manages water supply through the activation and deactivation of a motor pump, ensuring optimal moisture levels for strawberry cultivation. The integration of sensors andautomated control mechanisms facilitates precision farming, enhancing crop yield and resource efficiency in greenhouse cultivation. The key unit of the system is a remote controlling and management centre, which comprises of the sensing subsystem, the data acquisition subsystem, the information processing subsystem and the execution subsystem.

Keywords: temperature sensor and lighting sensor, activation and deactivation of motor pump, precision farming, remote controlling.

INTRODUCTION

One of the most crucial environmental elements for plant growth is light. It governs and controls fruit quality as well as plant growth. The three aspects oflighting are intensity, quality, and duration.

Within the visible spectrum (380 nm to 760 nm), photosynthesis occurs. Photosynthetic light is mostly produced by blue-voilet light, which ranges from 400 to 520 nm, and red-orange light, which ranges from 600 to 700 nm. The primary focus of research on artificial light sources at the moment is on how red, blue, and red-blue light regulate and govern many elements of plant development, photosynthesis, substance metabolism, and gene expression [1].

The use of 1.3 222 light-emitting diode(LED)lamps for indoor agricultural production has garnered increasing interest recently, and numerous types of LEDs have been the subject of experimental investigation. However, as artificial light is the only source of lighting in plant industries, research has mostly concentrated on the usage of LEDs in these settings. Few research have been done on adding

more light to a greenhouse to grow June-bearing strawberries. (Bula et a1., 1991; Watanabe,2011; Yoshida et a1.,2012,2016.In Japan, forcing June- bearing strawberries to grow in the winter is a typical practice; however, the yield is negatively impacted by the winter's decreased sun radiation. In order to increase strawberry productivity in greenhouses, we therefore sought to clarify the impact of supplemental lighting with LED lights in our study [2].

Thus, a prerequisite for scientific cultivation in a greenhouse setting is having a clear understanding of illumination information. Along with the use of artificial light or additional illumination sources in agricultural production is growing quickly due to scientific advancements and advances in agricultural technology. To enhance greenhouse lighting, high- pressure mercury, incandescent, fluorescent, and sodium lamps with significant energy consumption have been widely used in recent years. According to data, the horticulture sector uses 35% of the energy required annually by global agricultural production for its facilities; the cost of energy accounts for 15%to 40% of the entire cost of greenhouse crops. As a result, the energy consumption is high and not environmentally beneficial [4-6]. It is impossible to modify the light's intensity in response to the amount of natural light present and a certain temperature must always be maintained. [3]

The primary focus of the project is to develop an IoT-based Greenhouse Monitoring System using Arduino, with the aim of enhancing current agricultural practices through the integration of modern technologies to achieve improved crop yields. the project introduces a smart greenhouse model designed to automate farm tasks, reducing theneed for extensive manual inspections by farmers. The enclosed structure of the greenhouse offers protection against adverse weather conditions such as wind, hailstorms, ultraviolet radiations, and attacks from insects and pests [4].

The agricultural fields irrigation is managed through automatic drip irrigation, which operates based on preset soil moisture thresholds to ensure an optimalsupply of water to the plants. Utilizing data from soilhealth cards, the system can also administer the appropriate amounts of nitrogen, phosphorus, potassium, and other minerals through drip fertilization techniques. The project includes the construction of water management tanks, which are replenished based on the current level measured using an ultrasonic sensor. [5]

PROPOSED SYSTEM ARCHITECTURE

The kinetic energy from the footstep was collected using a piezoelectric sensor. The stress placed on a piezoelectric sensor's construction determines the output voltage of the sensor. The output voltage typically between 0 and 12 volts. The piezoelectric transducer is available in two sizes: circular and square. A piezoelectric transducer's circular shape is better suited to absorbing stress than a piezoelectric transducer's square shape. The piezoelectric sensors are wired in series and parallel configuration.

The generation of electricity using footsteps, also known as footstep power generation, is a promisingtechnology where, conversion process involves capturing the mechanical energy produced by walking or running and converting it into electric energy.

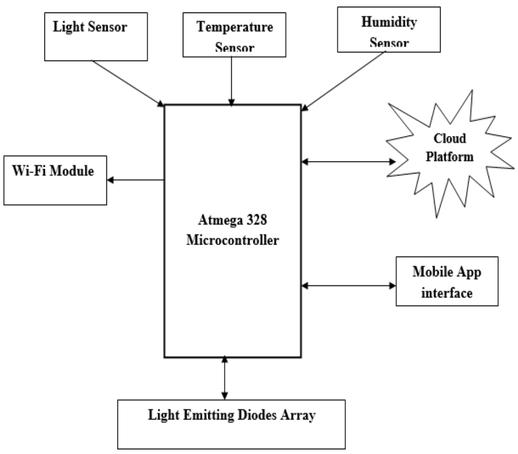

Fig. 1. Block diagram

Piezoelectric sensors are positioned below the floor tile to generate electricity by footsteps. The sensors are arranged in situation like this the way that maximum output voltage is generated which is thensent to circuit. This energy is then stored and can beused when it can be convenient. The basic idea of piezoelectric sensor is when the foot step is delivered, the piezo converts mechanical energy to electric charge.

HARDWARE REQUIREMENTS

1 Arduino Board:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs – illumination on a sensor, a finger on a button, or a Twitter message – and turn it into an output – activating a motor, turning on an LED, publishing something online.

2 Light sensors:

A Light Sensor generates an output signal indicating the intensity of light by measuring the radiant energythat exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infra-red" to "Visible" up to "Ultraviolet" light spectrum.

3 Temperature and humidity sensor:

Capacitive Humidity Sensor that measures the relative humidity in the air and Thermistor that Detects temperature variations, additionally there's a basic internal chip that performs analog-to-digital conversion. It then provides a digital signal containing both temperature and humidity data. These sensors are straightforward and slow, making them ideal for hobbyists interested in basic data logging. Reading the digital signal is relatively easy using any microcontroller.

4 LED Grow Lights:

Electric lights used to aid plant growth. Grow lights aim to offer a light spectrum that is more suited to the requirements of the plants begin grown, or one that is similar to the sun's spectrum. The grow light's spectrum outputs and colour temperatures, together with the intensity of the lights, are adjusted to simulate outdoor circumstances.

5 Relays or Transistors

Relays are on-off devices that act as switches and they are mechanical in nature, consisting of an electromagnet that controls a set of contacts. Upon coil energization, the contacts close, permitting current to pass through. Relays offer total isolation between the load and the activating circuit because they are segregated. One type of electronic gadget that can function as a switch is called a transistor. Similar to a relay, it permits control of a big current by a smaller current. However, a transistor functionssubstantially faster than a relay and is not mechanical like a relay.

6 Real-Time Clock Module

The DS3231 is a low-cost, highly accurate Real Time Clock which can maintain hours, minutes andseconds, as well as, day, month and year information. Also, it has automatic compensation for leap-years and for months with fewer than

31 days.

The module can work on either 3.3 or 5 V which makes it suitable for many development platforms or microcontrollers. The battery input is 3V and a typical CR2032 3V battery can power the module and maintain the information for more than a year. The module uses the I2C Communication Protocol which makes the connection to the Arduino Board very easy.

7 Wi-Fi Module (ESP8266 or ESP32)

A Wi-Fi module called the ESP8266 has became very popular in the maker and electronics communities, The ESP8266 is designed to provide wireless connectivity to various devices. Itresembles a tiny Wi-Fi enabler that can be integrated into projects. The ESP8266 allows devices to connect to Wi-Fi chip it also functions as a microcontroller it can write code for it. Control GPIO pins, and perform tasks.

CONCLUSION

In this study, we investigated if growing strawberries in Japan in conditions typically used to grow strawberries could result in yields that are higher when natural light is supplemented by LED lamps. The predicted amount of light received by plants is 30-60% when utilizing LED lamps with variable light quality (red/blue ratio) of 3:1 or 4:1 and setting the irradiation dose per day at 0.1458 mol m-2 s-1. An increase in yield ranges from 0.8 to 15%. Furthermore, adding LEDs to natural light significantly affected how plants arranged themselves in response to the extra light. This allowed photosynthetic products which are meant tobe used for spreading leaves to be used more frequently in fruits, which changed the ratio of fruitsto leaves.

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