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Research Article

Automatic Control And Monitoring Of Greenhouse System Using Iot

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Abstract: This paper presents an innovative idea for controlling and monitoring the environmental conditions like temperature, soil moisture, humidity, and light intensity associated with greenhouse by using Sensor Technology and Internet of things [IoT] devices. Solar Power system is used as a renewable energy source to feed the supply to the Arduino Board via the Rechargeable battery and Solar PV Panels. A greenhouse is nothing but a glasshouse, if it has sufficient heating point or a high temperature inside the greenhouse it is termed as hot house. It is a structure in which roofs and walls made chiefly of transparent material, such as acrylic sheet, glass, plastic, fibre-glass etc., in which plants requiring regulated climatic conditions are grown. Traditional method of controlling the greenhouse parameters has the capability but it yet lacks the capability of monitoring and controlling the parameters such as light intensity, indoor humidity etc., Many farmers are unable to make decent gains from the greenhouse crops because they are unable to control two main factors, that decides both the plant production i.e., crop yield as well as its growth. The temperature inside the greenhouse should not be lower than a certain degree, high humidity can results in water vapor condensation on different greenhouse surfaces, crop transpiration and evaporation of humid soil water. So thus we are implementing, this greenhouse monitoring and automatic control system to overcome those challenges. The proposed system consists of Solar PV panels, Rechargeable battery, Adapter, Sensors to control temperature, moisture of soil, humidity and light intensity, Wireless Network, Arduino UNO. 4 channel relay board and IoT Module. The collected data from the sensors is displayed ona customized website, android app and in LCD. Thus the proposed system has the advantage, that it can be accessible anywhere and at any time.

Keywords: Greenhouse, Internet of Things [IoT], Arduino UNO, Wifi-Module, Solar Power Conditioning Unit, Sensors

1. Introduction

Automated Greenhouse:

- Greenhouses are an integral component of a country's farming and horticulture industries.
- Greenhouses can be used to cultivate plants for optimum production under controlled climatic conditions.
- Automated greenhouse involves the automatic supervising and controlling of climatic factors which indirectly or directly governs the crop yield, growth and hence their production.
- Computer/software equipment is needed, In order to supervise and to control the climatic factors and environmental conditions associated with greenhouse autonomously.

A greenhouse is a wall constructed structure with a transparent roof designed to sustain controlled climatic conditions. Such structures are used for the cultivation of vegetables, fruits and various plants, which requires a certain amount of sunlight, humidity, and temperature and soil moisture. The Greenhouse Environment Monitoring and Controlling Project based on IoT and Arduino is planned to maintain those greenhouse conditions inside the system. In green house, plants like vegetables, fruits and flowers are cultivated. The sun-rays heats up the plant, soil and structure in the green house during day. Many diseases, such as soil borne ones, which splash onto plants in the rain are protected by green house. The effect of green house is a natural phenomenon which is useful to the agricultural people. This helps the farmers to make profits from the crops because they are able to control main factors that determine plant growth as well as productivity.

Various technologies have been used so far in monitoring and controlling the greenhouse parameters but it still need some requirements or else has some drawbacks in it. Some of its have discussed here: A greenhouse climate vision program has been developed for tomato production but they have used only two PAL colour cameras [5].An Embedded system approach are also used in monitoring the parameters but it has the disadvantage that only few parameters have been taken into account and it needs manual support for its operation [14]. Monitoring system using android with two sensors has designed to control the temperature and humidity, but it lacks to control other parameters which enable the plant growth [2]. Zigbee is also used to monitor but the result is quiet difficult to analyze because its range is limited one [9].

The proposed greenhouse surveillance and control system comes to rescue for meeting numerous challenges. This project illustrates the design and deployment of diverse sensors for monitoring and controlling the environment inside the greenhouse. This greenhouse control system utilizes the solar power for its operation. Arduino Atmega328p microcontroller which has inbuilt ADC is used to perform the operation by using its code. This greenhouse system consists of Light dependent Resistor [LDR], temperature sensor [DHT-11], 16 x 2 LCD display, soil moisture content sensing unit, Artificial lamp [Bulb], 12V DC fan, water pump, motor and water pipe. . Soil moisture sensor is used to check the moisture content level in the soil when it reaches a value less than the predetermined one, the pumps starts to run and it feeds the water to the plants via the water pipe. The level of temperature is sensed by the temperature sensor, if it is low, the DC fans are kept in off state and if it is high the fans are turned on, to make it cool inside the greenhouse. Light sensor (LDR) senses the light intensity level inside the greenhouse, whenever the light intensity is low, the AC bulb automatically starts to glow. By implementing this technique, it was quiet easy to supervise and to control the greenhouse system.

II. Objectives

- To create a miniature greenhouse with automated supervising and control system.
- This system work towards on increasing efficiency, increasing the crop yield by reducing its environnemental impacts and also it help in saving water.
- Track and track the atmosphere in the greenhousecontinuously to ensure that it stays at present temperature, soil moisture content, humidity and light intensity.
- The user can see the green house plants ambient conditions on the website and they can also monitor the green house parameters from distant locations [faraway places].
- Our aim is to build a weather controlled environment inside a greenhouse. We are working here on a system to provide a solution, which changes with the change in climatic condition on four parameters: Soil Moisture content level, Humidity, Light Intensity and Temperature.
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III. Making Of The Prototype

The prototype represents the model of Greenhouse supervising and automatic controlling system by using IoT environment. The monitoring and controlling is here incorporated with various sensors and IoT board, 4 channel relay board which are meant to enhance the controlling system. These sensors senses abnormalities and automatically convert the abnormal conditions into a normal one by using various components.

The components associated with our project are listed below:

Hardware Components Used:

1. Solar PV panels
2. Rechargeable Battery
3. Sensors (Data acquisition system):
    - *Soil Moisture Sensor*
    - *Light sensor (LDR)*
    - *Temperature and Humidity [DHT-11] sensor*
4. Arduino Board
5. 4 channel Relay Board
6. IoT Board
7. LCD Display
8. Devices controlled:
    - *Water pump and motor*
    - *Water pipe*
    - *Cooling Exhaust Fan*
    - *Artificial Lights (LED)*
9. Wifi-Module[for wireless communication]
10. USB Cables and Connecting Wires.

A. Hardware Components Description/Specification:

a)*Solar PV Panels and Rechargeable Battery:*

A Solar Panel (PV module) is, in very simple words, a system which will generate electricity flow under sunlight through the photovoltaic effect. Such energy can be used to charge batteries, which can drive regular household electrical appliances or “loads”, with the aid of an inverter. PV modules can also be found in grid-boot systems without batteries. In our proposed system with the help battery which stores charge from sunlight is used to provide a power supply to the system via the Arduino UNO Board.

b) Sensors:

(i) Temperature and Humidity Sensor [DHT-11]:

A DHT-11 temperature and humidity sensor detects or tests or measures both moisture content of air and air temperature. It is a wireless humidity and temperature sensor, which is of simple and lower in cost. The sensor consists of two sheets of metal and incorporates a non-conductive polymer layer between them. This film absorbs air moisture and causes the voltage between the two plates to change. These voltage variations are translated into digital measurements that indicate humidity level inside the house. In our proposed system it is used to monitor temperature as well as humidity level inside the greenhouse.

(ii) Light Dependent Resistor [LDR]:

The Light Intensity is an important parameter in the growth of plants. LDR senses the change in input intensity of light. If the strength of light is lower than the needed amount then it affects the plant production. Artificial lights are used to address low-light problem. Artificial light [LED] in this project is used for demonstration. In our proposed system, if the light intensity is less than the specified amount, the lights are switched on, and if the intensity of light reaches its usual value, the lights are turned off and an information message is displayed on a customized website

(iii) Soil Moisture Sensor:

The proportion of water volume present in the soil is measured by the moisture sensor. Since the direct way of measuring free soil moisture by using a gravimetric measurement involves weighting of a sample, drying and removing. The sensor does the measurement by using dielectric constant, electrical resistance of the soil. Soil moisture sensor may be used to measure soil moisture content level, when there is water scarcity in the soil, the module result is low, and otherwise the result is high. This sensing unit can help one to flower the plant automatically, or some other plants that requires automatic technique for watering.

c) IoT [Internet of things]

IoT is the interconnection of ordinary objects — sensors, software, physical devices embedded with hardware and plug-in connectivity that allows the sharing of data. Essentially, a small networked computer is connected to one object, enabling the information exchange from and to that object. The IoT board is used to assign parameter values to the custom platform [website] and to Android.

Different types of IoT boards are:

- System On Chip (SOC) boards
- Microcontroller based boards
- Single Board Computers (SBC) and so on.

d) 4 channel relay board:

A relay is a device which is operated electrically. Its operation is just like a switch. current creates a magnetic field through the relay coil, that draws a lever and modifies switch contacts. The coil current can be on or off, so relays have two switch places and there are double-throw (changeover) switches. It consists of a wire coil that surrounds an iron yoke or a soft iron core, which offers a low reluctance path for magnetic flux. In our proposed system we used three relays out of four, one for motor, one for Artificial light and another one for DC fan. 4 channel relay board is connected to the Arduino board, which gets 5V output from Arduino and its converts 5V to 12V. This voltage enables the operation of Water pump motor, Artificial Light and DC Fan.

B. Software Used:

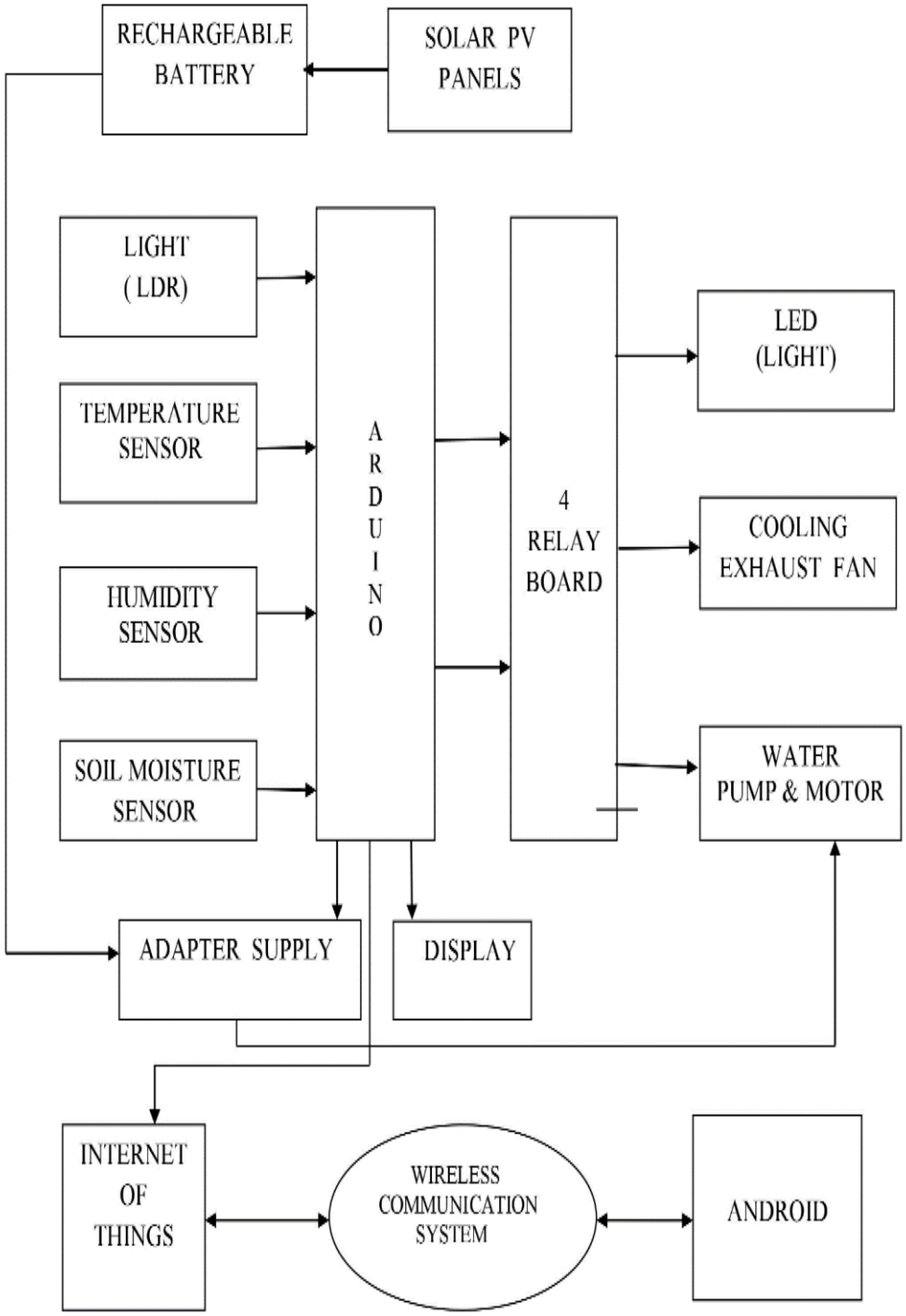
a). Arduino IDE

b). Proteus

Proteus is a professional tool for the modeling and construction of Electrical and Electronics circuits. It is a design and simulation software tool. The Proteus software suite includes systematic design and simulation of the circuits with PCB modeling.
ARES is used to build a PCB design. It has the function of displaying output along with the components in 3D view of the designed PCB. The Proteus 8 Design Suite software will communicate with LCD, LED displays, and even work with mobile sensors for embedded projects. In need of realistic execution the circuits of the program need to be checked with C program and to be tested whether it performs or not

C. Block Diagram:

Fig 1 depicts the block diagram of the entire system.



IV. Working Of The Prototype

The project proposes the method of supervising and automatically controlling the environmental factors associated with greenhouse such as humidity, temperature, light intensity and soil moisture content. The Solar PV panels grab the sunlight and stores the charge in the rechargeable battery. The battery feeds the supply to the Arduino Board via the adapter. The Arduino UNO based on the ATmega328p is a Microcontroller Board used in our proposed system. It is a high performance controller and it is efficient and economical. Arduino UNO board is used to interface the sensors that is used to control and monitor the environmental parameters associated with plants growth. Three sensors has been used in our proposed system i.e., DHT 11 which is used to monitor the temperature and humidity level inside the greenhouse, Moisture sensor is senses or monitor the

level of humid content in the soil and LDR Sensor to monitor the light intensity. The interfacing unit (4 channel relay board) is used to connect the controlled devices. The other side of Arduino board is used to connect the Water pipe, water pump and motor, Cooling exhaust fan, Artificial lights [LED] to the power supply. If the temperature goes beyond the Set temperature (i.e., programmed in Arduino Software) immediately DC fan goes to on state to mitigate the temperature level inside the greenhouse. If the soil moisture level is lower than the set value, immediately the water pump gets operated and it feeds the water to the plants via the water pipe. If the light intensity level is less than the set value, then the AC bulb gets glow on to increase the light intensity level. All these operations happened automatically without any manual support. All the values of sensors are displayed on a customized website, android app and in LCD display. So thus we can monitor the values from anywhere and at any time by using various sources. The simulation is also done by using a Proteus Software in which all the operations are depicted there.

a)*Working flowchart:*

The system is clarified using the flowchart; it was illustrated by comparing the set values with the acquiring values as shown in Figure. First step is to enter the values of the greenhouse parameters like moisture content of soil, temperature, humidity and light intensity and upload these values into sensing and response unit to comparing with acquiring values. If the set temperature less than the acquired temperature the Arduino UNO [Based AtMega328p] Microcontroller send signal to run the fan, else the fan is in off state. If the set light intensity level greater than the acquired light the microcontroller send signal to ON the lamp, else OFF the lamp. If the set soil moisture content level is greater than the acquired soil content level, the Arduino UNO [Microcontroller] send signal to open the water pipe valve to feed the supply to the plants, else water valve is in close state. The values of the environmental parameters are displayed on a customized website, android app and in LCD Display.

b) Prototype of proposed system:

The prototype of the proposed system is shown in Fig 3. The system is tested and the results are obtained and found satisfactory.

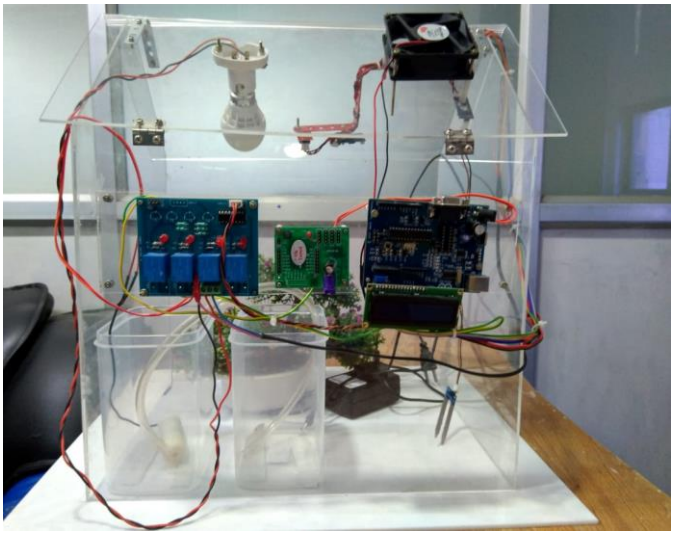


Fig 3: Prototype of the System

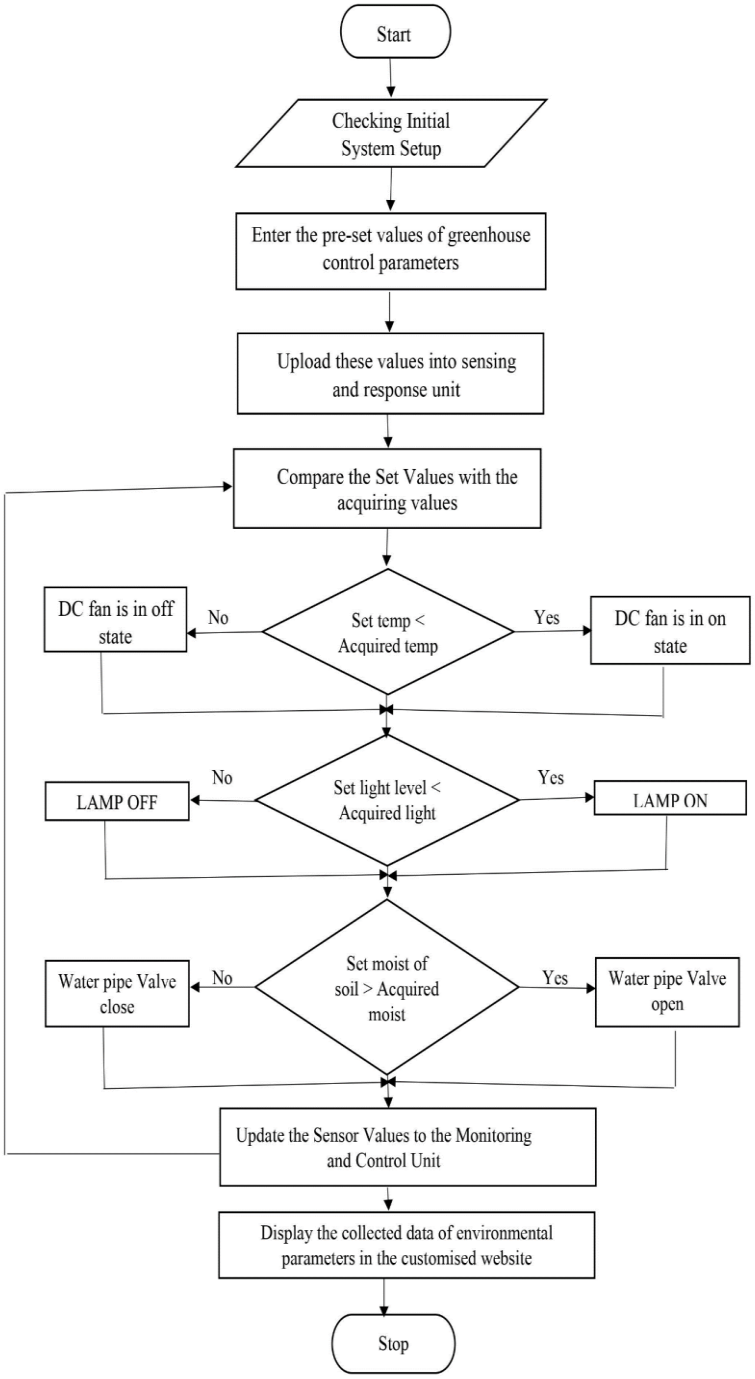


Fig 2: Working chart

V. Results And Discussions

This system aims at the supervising and controlling of the environmental factors automatically without any manual support. The result has been got from our proposed system which displays the values of soil moisture content level, temperature; light intensity and humidity level in the LCD board and the values of these parameters are also displayed on a customized website via wireless communication and IoT. App is also designed to monitor the parameters from various locations. The simulation is performed and the results are verified by using Proteus software. Fig 4, 5, 6 respectively show the results of LCD display, Webpage and Simulation.

Fig 4: LCD Display

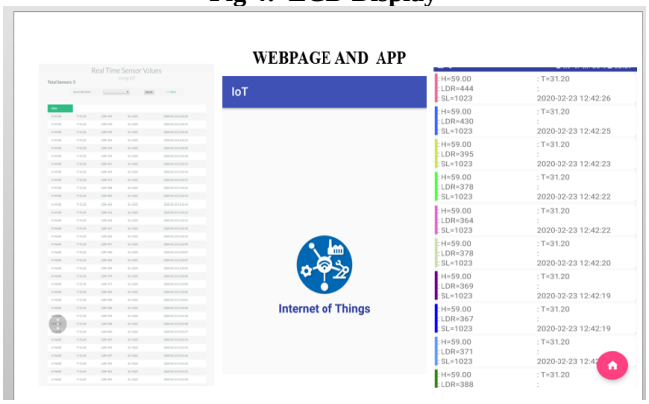


Fig 5: Webpage Result

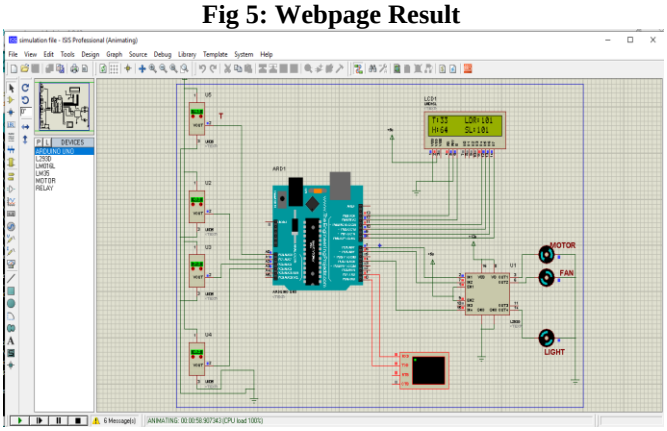


Fig 6: Simulation Result

VI. Conclusion

With the wide enhancement of IoT, Wireless and Sensor technology Light Controlling system, Cooling System and Water supplying systems are employed. Solar panels with the help of sunlight can charge the battery during the daytime and IoT devices which consists of various wireless sensors network which can sense the different environmental parameters. The proposed system used effectively to supervise and to control the green house environmental factors with the help of sensors and it works more effectively in the crop production with the low initial cost for setup. The system can be applied with the assist of many technologies, however these technologies are more reliable, clean to implement, works more efficiently in addition to this, it is easy to operate and it also saves human effort, money and time consumption. The three main sensors used in our proposed system are Temperature & Humidity [DHT-11] sensor, Light Intensity Sensing Sensor and Soil Moisture Sensor which gives the accurate value of temperature, humidity, light intensity and moisture respectively. Those sensors give the right result depending on the plant's condition as well as farm area. Such findings and results can be viewed on the project LCD board and on a customized website**.** Controlling the environmental conditions inside the greenhouse automatically allow every form of plants to be cultivated throughout the year. This eliminates the possibility that the greenhouse will not be sustained risk of greenhouse not being maintained due to the occurrence of human error at specific environmental conditions. The proposed system also minimizes labour costs involved in maintaining a greenhouse system.

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