

Design & Development of Low Cost Automation for Polyhouse

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Abstract— The function of a Polyhouse is to create the optimal growing conditions for the full lifecycle of the plants. The objective of our project is to design a simple low cost automation for Polyhouse so that the plants may grow in any favourable conditions without any loss to farmers. This design can be used for controlling of temperature and humidity inside the Polyhouse, remove moisture from Polyhouse in rainy season and giving specific amount of sunlight by opening roof top, and uniform path for spraying the pesticides to plants by making less manual work.

Keywords: Poly House, Green Houses, Cultivation, Temperature, Humidity, Spraying Method

I. INTRODUCTION

Although traditional farming is prevalent in India, now new farming technology like Polyhouse farming provides better income. The greenhouse covered with simple polyethylene sheet is termed as Polyhouse. The function of a Polyhouse is to create the optimal growing conditions for the full lifecycle of the plants. It reduces dependency on rainfall and makes the optimum use of land and water resources. Polyhouse farming enables cultivation of crops that can give maximum yield on specific days and exotic crops that can't be normally grown in Indian conditions. It provides better income in short period of time with less labor. It reduces dependency on rainfall and makes the optimum use of land and water resources. Polyhouse farming can help the farmer to generate income by growing multiple crops within short period of time. ^{[1][4]}

Flower size and stem length are two important factors that dictate the value of cut-flower roses. Optimization of rose cut-flower production requires the ability to predict the response of plants to various environmental conditions, particularly air temperature. Temperature and light have been found to be the primary factors of rose crop growth and development. The number of days from bud break in 15°C is about 3 times of that in 30°C.

From below Fig-1 it is clear that the temperature and humidity plays an important role in quality of flowers and value of flowers from the market. Important to note that if temperature inside polyhouse if increases from 28 degree to 40 degrees with two hours the flowers will reach from stage 1 to stage 4 thus the loss of value of flowers will be $(150 - 30) = 120$ Rs per bunch of flowers which is very high, hence there is a need to control this temperature fluctuation by a suitable automatic method.

II. PROBLEM STATEMENT

Presently there is no automation in this field. Manual control is done by use of blowers and windows that are again operated manually if the temperature is found to increase beyond the permissible limit. It is extremely important to control temperature and humidity inside the Polyhouse by using door opening and closing mechanism.

When there is change in season then it is necessary to maintain the temperature inside the Polyhouse for this purpose roof top mechanism is used in rainy season. Presently there is no such solution for farming in rainy season. Pesticides are necessary for plants but this may harm to human being for avoiding infection we have to use spray mechanism so that it's not necessary for man to enter into the Polyhouse for spraying pesticides.

III. OBJECTIVES

- 1) Design development and analysis of Rain sensing roof – top cover mechanism to cover the poly house roof on the left hand and right hand end automatically.
- 2) Design and development of temperature sensing automatic vent door opening mechanism coupled to an axial blower that will drive the hot and moist air out of Polyhouse and maintain temperature within specified range.
- 3) Design and development spray mechanism to spray pesticide all over the plant area on both sides and top of the plant to give maximum cover in a man less operation of spraying.

IV. DESIGN

Important design consideration in this paper is summarised as below

A. Vent Door Opening Mechanism:

When the temperature or humidity increases above the specified limit both the blower and the vent door opening mechanism motor operates together. At first the when the motor of the door opening mechanism operates it turns the crank of the link such that the door open in the outward direction thereby creating way for the hot air out. Now blower blows the hot air out of the poly house though open vent door and fresh cold air enters the poly house that dilutes the in inside Polyhouse to bring down temperature and humidity back to normal or desired value.

When the temperature or humidity drop to the specified limit both the blower stops and the vent door mechanism returns back to original position thereby closing the vent doors.

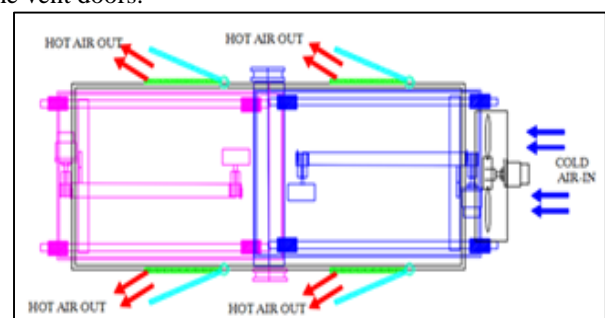


Fig. 1: Schematic diagram of Door Opening Mechanism

Sr. No.	Part Name
01	Vent Doors
02	Hinges
03	Links –Set
04	Motor
05	Crank
06	Connecting Rod
07	Sider
08	Blower
09	Temperature and Humidity Sensor

Table 1: Parts required for door mechanism

B. Roof Top Mechanism:

When the rain sensor senses rain it operates the motor which rotates the timer belt drive, the belt moves the cover from right to left on the slider mechanism with help of linear slide bearing to give a very smooth operation in minimum time. Counter weight moves up and ensures that proper tension is maintained in unwinding of the over on the roller drum.

When the rain stops circuit operates the motor which rotates the timer belt drive, the belt moves the cover from left to right on the slider mechanism with help of linear slide bearing to give a very smooth operation in minimum time. Counter weight moves down and ensures that proper tension is maintained in winding of the over on the roller drum without any wrinkle.

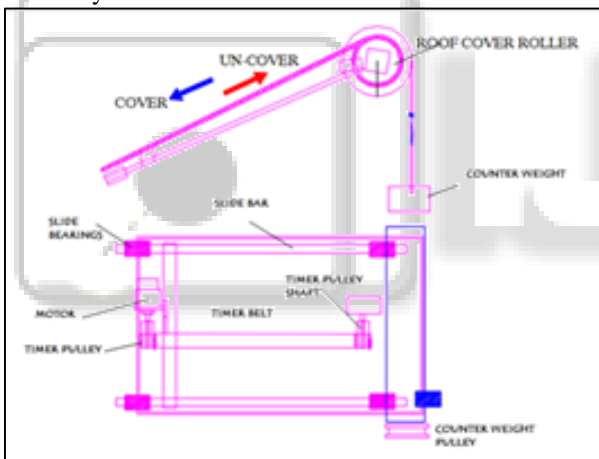


Fig. 2: Schematic diagram of roof top mechanism

Sr. No.	Part Name
01	Roller
02	Bearing Housings
03	Bearings
04	Roof Cover Sheet
05	Slider Bars
06	Slider Bearing Housing
07	Slider Bearing
08	Timer Belt Pulley Shafts
09	Bearing Housings for Pulley
10	Bearings for pulley
11	Motor
12	Timer Belt
13	Slider Bar Holder Plates
14	Counter Weight Pulley
15	Counter Weight

Table 2: Parts required for roof top mechanism

C. Spray Mechanism:

The automatic spray circuit makes the spraying makes the operation of pesticide spraying-man less. Thus there is no risk of disease or danger for the poly house worker due to inhaling of pesticide.

Pump is operated to supply pesticide to the spray mechanism, which travels forward and backward on the slide bars using a motor operated screw and nut mechanism.

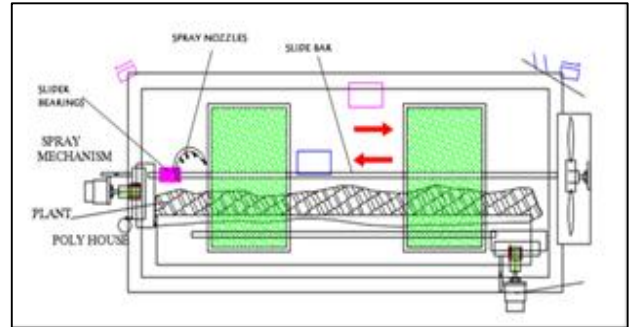


Fig. 3: Schematic diagram of Spray Mechanism

Sr. No.	Part Name
01	Screw For Translation
02	Bearing Housings
03	Bearings
04	Sprayer Set
05	Slider Bars
06	Slider Bearing Housing
07	Slider Bearing
08	Slider Bar Holder Plates
09	Motor
10	Spray Nozzles
11	Pump For Sprayer

Table 3: Parts required for spraying mechanism

V. ELECTRICAL CIRCUIT

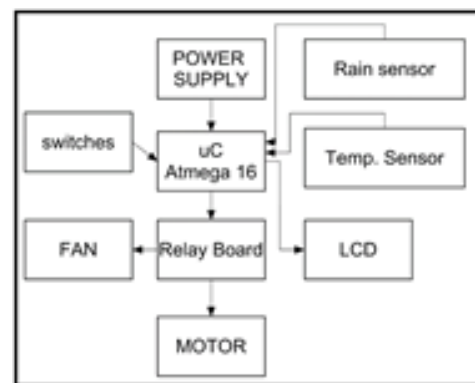


Fig. 4: Connection of electrical circuit

A. AVR Microcontroller (Atmega 16):

The microcontroller used is, Low-power AVR® 8-bit Microcontroller, having 8K Bytes of In-System Self-programmable Flash program memory, Programmable Serial USART, 8-channel, 10-bit ADC, 23 Programmable I/O Lines.

1) Atmega 16 Features:

- Low-power AVR® 8-bit Microcontroller
- 16K Bytes of In-System Self-programmable Flash program memory

- Programmable Serial USART
- 8-channel, 8-bit ADC
- 32 Programmable I/O Lines
- Operating Voltages
 - 2.7V - 5.5V for ATmega32L
 - 4.5V - 5.5V for ATmega32
- Power Consumption at 1MHz, 3V, 25°C
 - Active: 1.1mA
 - Idle Mode: 0.35mA

B. Temperature Sensor LM35:

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^{\circ}\text{C}$ at room temperature and $\pm 3/4^{\circ}\text{C}$ over a full -55 to $+150^{\circ}\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level.

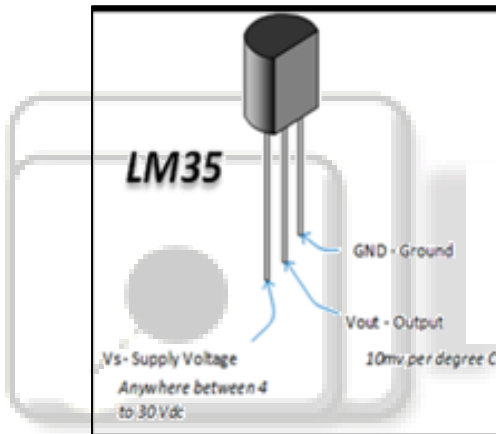


Fig. 5: Temperature Sensor

C. LCD:

JHD162 LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.



Fig. 6: LCD

D. Rain Sensor Module

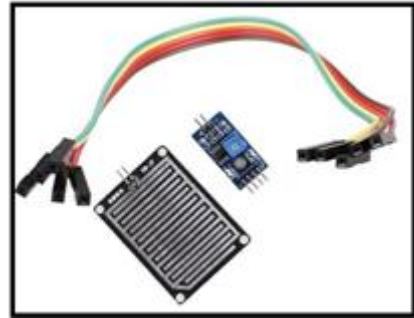


Fig. 7: Rain sensing module

1) Description

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity through a potentiometer.

2) Specifications

- Adopts high quality of RF-04 double sided material.
- Area: 5cm x 4cm nickel plate on side,
- Anti-oxidation, anti-conductivity, with long use time;
- Comparator output signal clean waveform is good, driving ability, over 15mA;
- Potentiometer adjust the sensitivity;
- Working voltage 5V;
- Output format: Digital switching output (0 and 1) and analog voltage output AO;
- With bolt holes for easy installation;
- Small board PCB size: 3.2cm x 1.4cm;
- Uses a wide voltage LM393 comparator

VI. CONCLUSION

The main advantage of this system is that it reduces manual work and there is no need of any external training to farmers. In Polyhouse, farming of a particular plant it is necessary to maintain the temperature inside the Polyhouse for proper growth of plants. To control temperature, we have used temperature sensor which senses and controls the closing and opening of doors. When the temperature increases above the pre-set values, door is opened till desired value is obtained.

In rainy season moisture gets accumulated on the sheet of the Polyhouse due to which specific amount of sunrays may not enter so roof top mechanism is used which is signalled by rain sensor module then the roof top opens and closes when it rains.

Spraying mechanism avoids human interference in the Polyhouse which prevents infection to the farmers and there is uniform spraying of pesticides to the plants.

VII. FUTURE SCOPE

The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of microcontroller.

The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time.

These system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

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