AUTOMATIC MONITORING AND CONTROLLING SYSTEM USING PLC FOR MUSHROOM PLANT

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ABSTRACT:

The white button mushroom is very popular throughout the world and is the most important mushroom of commercial significance in India. It can be successfully cultivated in places where the environmental conditions are favourable but it is cultivated in North India in winter seasons due to the favourable conditions. The optimum temperature for mycelial growth is 22°C- 25°C and that for fruit body formation 14°C -18°C and a high percentage of relative humidity. The mushroom cultivation rooms should have facilities for temperature control and pasteurization processes. The main aim of this paper is to minimize the human care needed for the mushroom plant by automating the mushroom production plant and monitor the crop room environment status. The control system is design with PLC Naxgene 1000 .Temperature transmitter is used to detect the temperature. PID controller valve, sprinkler, 12 volt fan is also installed and turn ON when the temperature is too high design an automated mushroom plant monitoring and controlling system which is purely sensor based and can manage everything with minimal human interference. By using the output signals given by different sensors PLC will maintain the appropriate conditions for the proper growth of plants.

KEYWORDS: Mushroom, PLC, PID controller, Temperature transmitter, Co2 sensor, Humidity sensor.

I. INTRODUCTION:

Mushroom production is a growing business in India as the demand is increasing from last few years. Mushroom cultivation is a matter of practice and technical knowledge rather than labour intensive farming with a high value of return in short time. For mushroom mycelium growth in the casing soil, temperature is in the room is maintained around 24°C for next 7–10 days. When the casing soil is infiltrated with mushroom mycelia, room temperature is brought down to 14°C–18°C and ample ventilation is provided to reduce CO_2 level, preferably below 1,000 ppm. These conditions initiate the fruiting in mushrooms. The relative humidity of the room is maintained between 85 and 90% all the time. The casing layer is given light spray of water to prevent its drying and for evaporation. The quality and productivity of the mushroom plants is highly dependent on the management quality and a good management scheme is defined by the quality of the information gathered from the mushroom plant environment.

The main aim of this paper is to minimize the human care needed for the mushroom plant by automating the mushroom production plant and monitor the crop room environment status. The scope of work is classified into hardware development and programming. The hardware section includes the designing of the mechanical structure and electronic circuits. Software section design to control the automated mechanism. The program has a function to maintain the appropriate temperature in crop room.(ii) activate the ventilation system when the main system detects the indoor temperature is too high or low for the environment.

The main motivation of this design is to help the user to take care of their button mushroom plant. With the intelligent features installed, the system will have the ability to react to specific weather. A single unit of the button mushroom production plant (crop room) has been constructed and integrated with sensors as input to

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dedicated output. PLC Naxgene 1000 is used to control the system, temperature transmitter, humidity sensor, co_2 sensor are used to measure the environment in the crop room.. PID controlled valve, sprinkler and a 12V fan is also installed and turn ON when the temperature is high.

II. LITERATURE REVIEW:

In [1] authors used embedded technology to develop monitoring and controlling system for the digital greenhouse using AT89C51 ,It control the value of temperature, humidity, light intensity, and soil moisture that are continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield. Sometimes robot also placed in farm to monitor the farming status with the help of sensors. In [2] authors proposed the greenhouse auto control system based on wireless sensor network. It collects the environment information in the greenhouse. To create an optimal environment, the climate and environment parameters need to be controlled. An automated system for greenhouse using Supervisory Control and Data Acquisition (SCADA) tool like Lab view is described in [3] by S.H.Sadati, A.M.Sahari. In [4] David Whiting, Scott Johnson has outlined the factor that will affect the plant growth. One of the most important factors that they proposed is temperature. Temperature consideration directly affects the outcome of a plant growth. [5] The Greenhouse system is a time-varying, extremely non-linear and multivariable. In [6] the recent inventions in high rise manner in search of solution to susceptible effects of climate change in Australia have been discussed. The vertical Architecture Studio (VAST) shown by selected projects for a prototypical vertical garden city is useful and differs significantly from other built-up forms. In [7] Embedded based greenhouse monitoring system using PIC 16F877A microcontroller is used. Which deals with simple ,easy to install, microcontroller –based circuit to monitor and record the value of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order to achieve maximum plant growth and yield but the performance of the system can be further improved in terms of the operating speed , memory capacity , and instruction cycle period of the microcontroller so for this reason PLC controller are used in this project by which the number of channels can be increased to interface more number of sensors which is possible by using PLC.

III DESIGN METHODOLOGY:

The proposed system is used for controlling the parameters like temperature, co_2 level, humidity of mushroom production plant which is shortly describe in block diagram. Temperature is control by using instruments like temperature transmitter, humidity sensor, co_2 sensor, PLC, PID control valve. These all instruments are in system communicated with each other in closed loop system. The project overview is shown in Fig. Where the block diagram of this project, showing how PLC, Temperature sensor, co_2 sensor, control valve and temperature transmitter are related to each other to form a closed loop system.

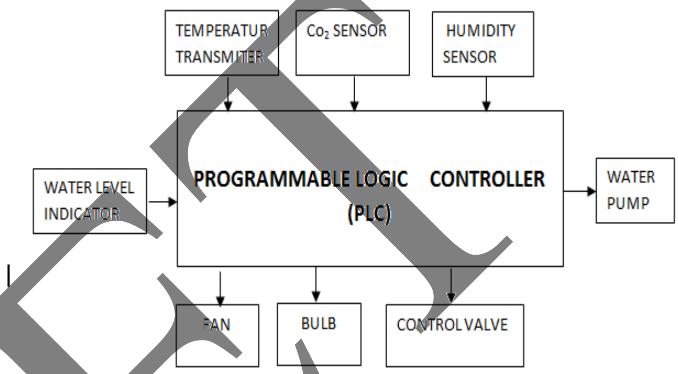


Fig 1: Block diagram of proposed design

(I)PLC PROGRAMMABLE LOGICAL CONTROLLER:

A programmable logic controller (PLC), or programmable controller is an industrial digital computer. PLC Naxegen 1000 shown in fig 2. required 24 V DC operating voltage with Memory: - non-volatile battery backed RAM, Compact Base Unit packed with 14/16 feature rich I/O points, Expandable up to 80 I/O Points with 4 Expansion Modules ,Memory Application is 128 Kb, Data: 28 Kb Storage of complete Project with Comments on CPU

Fig 2: PLC Naxgene 1000

II) CARBON DIOXIDE SENSOR:

T5440 Co2 sensor shown in fig 3. is an instrument for the measurement of carbon dioxide gas. The measurement principal is based on the NDIR principal with dual wavelength which automatically compensates for aging sensor .The transmitter contains a microprocessor based control circuitry is build inside the case Large dual line LCD is an advantage, It range is from 0 to 2000ppm, and require 9-30Vdc power supply, its weight is approximately 145g.Measured co2 concentration values are converted to RS485 serial output.

Fig 3: CO_2 sensor

(III) TEMPERATURE TRANSMITTER:

The PT-100 RTD is a platinum-based RTD sensor module shown in fig. 4 are used as input. It can be used to measure temperature with an electrical output proportional to the temperature (in ^{0}C). For PT-100 RTD shown in fig.3 has an impedance of 100 Ω at 0°C and approximately 0.385 Ω of resistance change per 1°C change in temperature. This impedance results in 18.52 Ω at −200°C and 390.481 Ω at 850°C. long-term stability makes accurate infrequent Calibration possible.

Fig 4: Temperature transmitter

(IV) HUMIDITY SENSOR:

The humidity sensor module shown in Fig. 5 consist of a hygroscopic dielectric material sandwiched between a pair of electrodes forming a smaller capacitor. At normal room temperature, the dielectric constant of water vapour has a value of about 80, a value much larger than the constant of sensor dielectric material. The duct mount Rh Sensor H7080B3273 has an ±3accuracy and the RH Output (0 to 100%): 4-20mA / 0-10VDC, it require a 24VDC /AC power

Fig. 5 Humidity sensor

(V) FAN:

an is another output that reacts when temperature is too high .Any DC Fan is allowed to install in the design as long as it can be powered by 12V power supply.

(VI) IMPLEMENTATION:

The implementation of the design is includes the structural design .When we designing the structure, several conditions have to be taken into account, mainly, cost and ease of use. The PLC can be used as a standalone device and also be interfaced with sensors, connected to a computer and HMI Programming of the PLC naxgene 1000 is done using the Codesys 2. 3vThe programming language used is called ladder diagram. The system input from three sensor module, temperature sensor, humidity sensor, co2 level sensor. At the start of the programme, initialization is made and the sensor module is power up. The optimum temperature required for mycelial growth is 22°C- 25°C it is for 7 to 8 days and that for fruit body formation 14°C -18°C and a high percentage of relative humidity. In normal operating condition the correct temperature reading is transmitted. At the same time, the temperature, humidity and co2 level is constantly compared with the threshold set for humidity and temperature condition.

The flowchart of the automated mushroom plant design is shown in Fig. 6

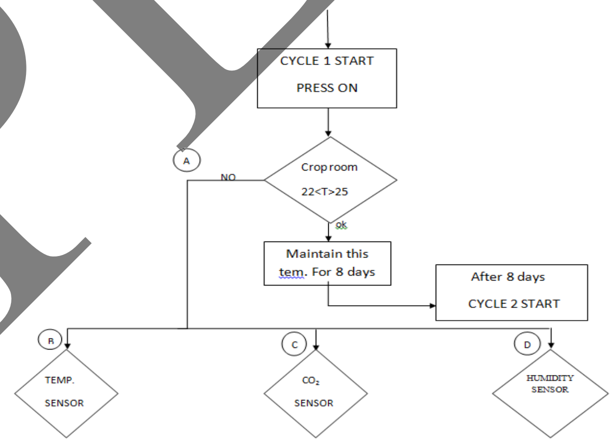
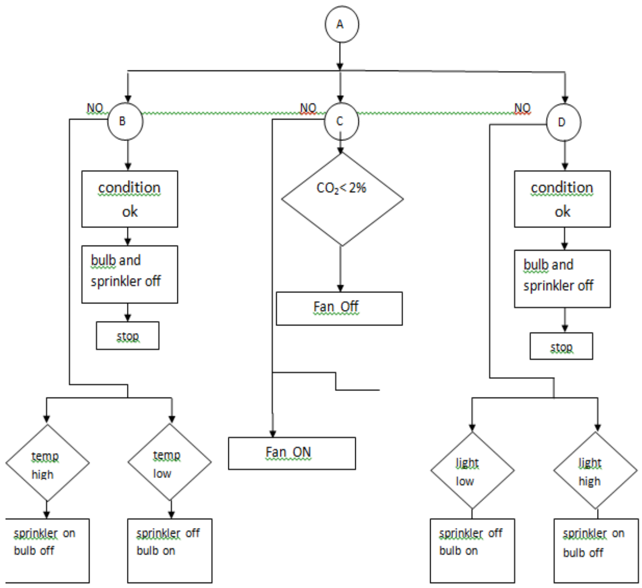


Fig.6 Flow chart of the system



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4. EXPERIMENTAL RESULTS AND DISCUSSION:

After the feasible result obtain from the simulation, real time implementation of the mushroom production plant monitoring program is done. Successful interfacing with the sensor and the PLC, The performance of the device is tested for different temperature, co2 and Humidity level and results are recorded. Predicted actions are shown in Table 1.

Table 1: Action on condition

:DEV_COMMENT	MIN TEMP SP	MAX TEMP SP	ACTUAL TEMP	CV OPENING	HUMIDITY	
:DEV_TYPE	BIN16	BIN16	BIN16	BIN16		
:DISP_TYPE	MIN TEMP SP	MAX TEMP SP	ACTUAL TEMP	CV OPENING	HUMIDITY	CO2
:DEV_SIZE	1	1	1	1		
01-01-2000 00:02	0	25	50	25	90	2
01-01-2000 00:02	0	25	50	26	90	2
01-01-2000 00:02	0	25	50	26	89	1
01-01-2000 00:02	0	25	49	26	88	1
01-01-2000 00:03	0	25	48	26	85	1
01-01-2000 00:03	0	25	46	26	84	1
01-01-2000 00:03	0	25	46	24	83	1
01-01-2000 00:03	0	25	46	25	82	1
01-01-2000 00:03	0	25	46	25	81	1

5. CONCLUSION:

A step-by-step approach in designing PLC based system for measurement and control of the three essential parameters for the plant growth i.e. temperature, humidity, co2 level has been followed. The wider acceptance of electronic system in agriculture, and an emerging agriculture control system industry in several areas of agriculture production will result in reliable control system that will address several aspects of quality and quantity of production.

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