Different Automatic Monitoring and Controlling Technique for Mushrooms

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Abstract: Automation of mushroom farms can greatly reduce the human effort in maintaining suitable environment for mushroom growth by automatically controlling temperature, humidity and C02, thereby reducing overall cost and increases high production in mushroom yield. So it becomes very important to select the type of automation which suits to the farmer's requirement and investment and ease of operation. This paper compares the various automation technologies that can be used in mushroom farming. This study should help the farmers to select the type of automation he can choose from the available automation technologies available around the world.

Keywords: Mushroom Farm Automation, controller based mushrooms, microcontroller, temperature and humidity sensor.

1. Introduction

Mushrooms consumption has increased from the last ten years mushroom is a fungi used as a food in daily life because it has various nutrients, proteins, carbohydrates, minerals and vitamins. It is like a Meat for a vegetarian people. In addition to this ,mushrooms has many other medical benefits such as it reduces obesity , diabetes , heart diseases and also can be used to reduce side effect of chemotherapy in cancer treatment and also help in creating immunity for cancer in normal person also . Mushrooms have all the important nine amino acids required for human growth which are retained even after cooking. India is primarily agriculture based country and produces large amount of agricultural waste .This agriculture waste can be used for cultivation of mushrooms which can produce extra income to landless farmers, unemployed youths .in addition to this it will reduce air pollution produce by burning this agriculture waste. So mushrooms have the capability to make rural people financially independent.

Due to its high demand bigger farmers around the world has started cultivating the mushrooms using modern technologies but still most of small farmers in India are not able to get high yields in mushrooms as it is very difficult to manually maintain suitable environment for mushrooms in addition to this small farmers in India are poor and very less technically educated and this make them not able to select advance automation technology. This paper helps the farmers to select suitable automation techniques according to their needs so we have compared the various automation technologies available around the world in this paper that can be used for mushroom farming according to their cost, complication, features, reliability, ease of operation, limitations, advantages and disadvantages.

2. Different Automatic Monitoring and Controlling Technique for Growing Mushrooms.

There are many automation techniques that can be used for automation of mushroom cultivation depending upon the cost, complexity, feature etc. some techniques are:

a) Thermostat Controllers

b) Microcontroller based Automation with serial cable communication

c) Microcontroller based Automation with Bluetooth, Wi-Fi and Zig bee communication

d) IOT Platform Based automatic monitoring and

e) PLC based automatic monitoring and control

2.1 Thermostat Controllers

Controllers are small digital microcontroller based devices which has input and output capabilities. It has inbuilt preprogrammed microcontroller by the manufacturer with required circuitry for measuring and controlling temperature .they are available for use in small isolated chambers like egg incubators and has ability to read only one or two parameters like temperature, humidity, pressure and can control these parameters depends upon the slave device connected to it such as fan, Lamps, heater etc. No communication and interfacing is available in it. It is cheapest of all and requires no professional skill to install. Figure 1.shows digital thermostat controller available in market .Figures 2 shows the internal parts of thermostatic controller. It is divided into sensor terminals, seven segment display and relay for connecting temperature adjusting equipment. It and power supply system which contain voltage reducing circuitry so that microcontroller can work.

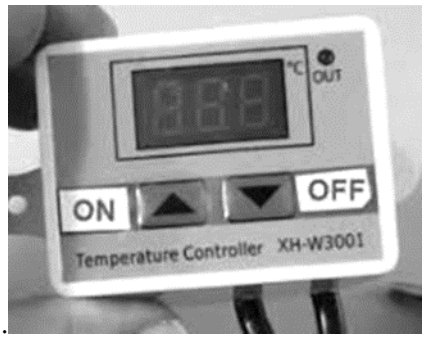

Figure 1.Thermostat controller

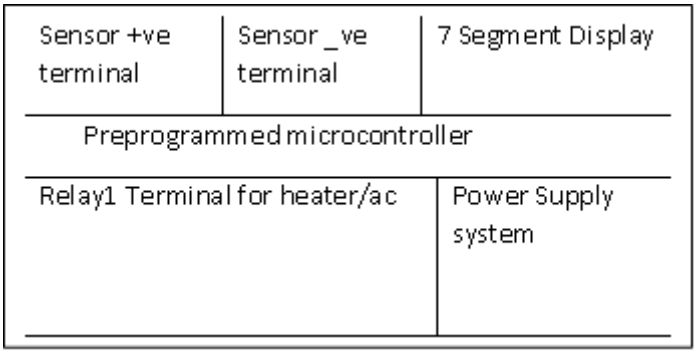

Figure 2. Basic Parts of Thermostat Controller

2.2Microcontroller based Automation with serial cable communication

This type of automation requires skilled professional to program the microcontroller and sensors like humidity and temperature sensor and output devices such as sprinkler, exhaust fan, lamps etc. A program is feed to memory of microcontroller board with set parameters to turn on the output devices after sensing the input sensors like temperature and humidity. Data cable interface is available for programming. Fig. 3 shows the parts of this system. Arul Jai Singh. S et al. in [1] has proposed a PIC16F877A microcontroller based model to watch ,record various measurement values such as humidity ,temperature ,light by placing sensors in natural environment and adjust the environment parameters by controlling Fogger , cooler, dripper and lights through relays to optimize the environment required to get maximum crop yield. In addition to this LCD and buzzers also incorporated for green house condition monitoring and buzzer beeps during fault detection.

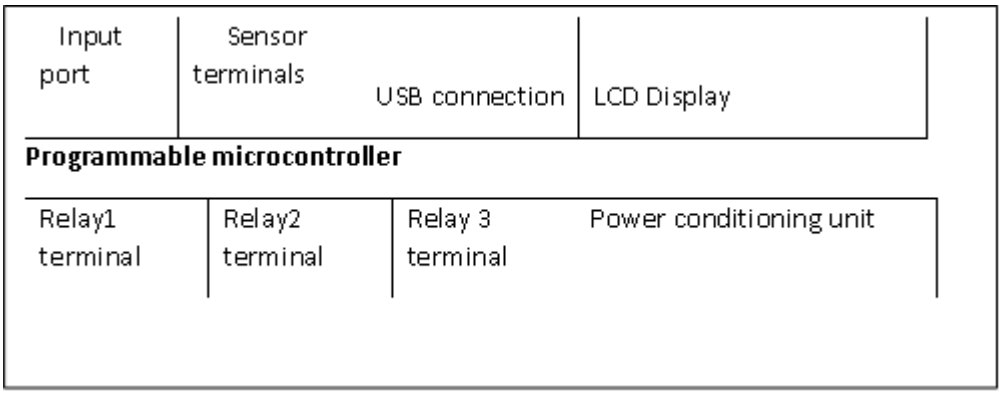

Figure .3 Basic parts of Microcontroller based system

Junifer B. Frenila et al. in [2] presented a solar powered automatic model for mushroom farming in a plastic box for a disaster hit area. it uses Arduino Uno microcontroller board, DHT 11 for measuring temperature and air moisture values, hygrometer, Lcd for displaying sensor parameters and relay module to control water sprinkler and fan , for giving power to this there is solar panel connection and there is a commercial electricity connection if solar power is not available and a 12v regulator for power conditioning.

Ardabili et al. in [4] has presented a modeling scheme for environment parameters of mushrooms by comparing the two fuzzy logic and digital (ON/OFF) control for adjusting the humidity, temperature and C_{02} concentration. The data gathering and parameters study is performed by using MATLAB Simulink tool and it is

seen that fuzzy logic controlling has less standard deviation, variance and error and it also has lowest fluctuation and has showed improved result in process controlling.

2.3 Microcontroller based Automation with Bluetooth, Wi fi and Zig bee communication

This system is same as above system only difference is now user can remotely monitor and control device depending upon the which communication devices is used like Bluetooth has 10 m range, Wi Fi has 50 meter and Zig bee has 100 meters range .Wireless sensors can also be used with them to eliminate error due to using longer wires. Fig. 4 shows the parts of this system Xiaochen Ma et al. in [3] has purposed a green house environment control design using microcontroller STM32 ARM. The STM32 is used as a collection node for various sensors such as temperature, soil moisture and humidity.

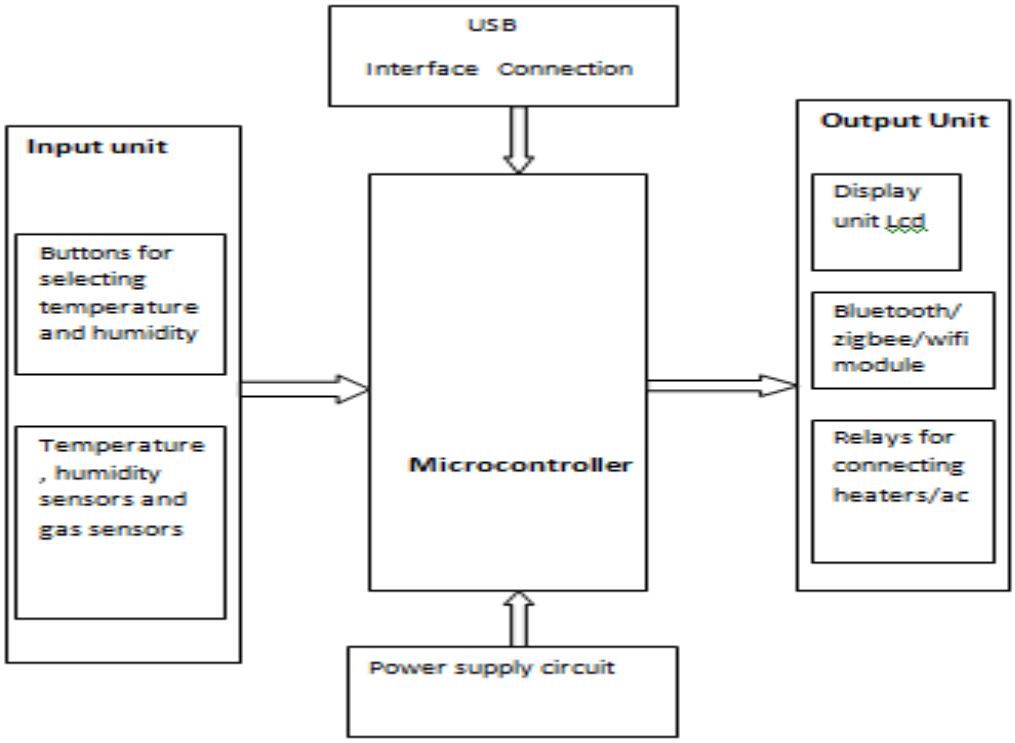

Figure 4. Basic Microcontroller system with Bluetooth/Zig bee / Wi fi Communication link

2.4 IOT Platform Based automatic monitoring and control.

Internet of things is a cloud platform used to store sensors data and logging for monitoring, analyze and control devices connected with Node microcontroller using Blynk android application and thingspeak on mobile phone. Fig. 5 shows the parts of this system. Jirapond Muangprathub et al. in [5] has made a system for irrigating crops using wireless node system for measuring humidity, soil moisture, etc. This paper presented a control system using node sensors in the agriculture crops area and irrigation control is managed on android phone, mobile phone and web application using suitable hardware.

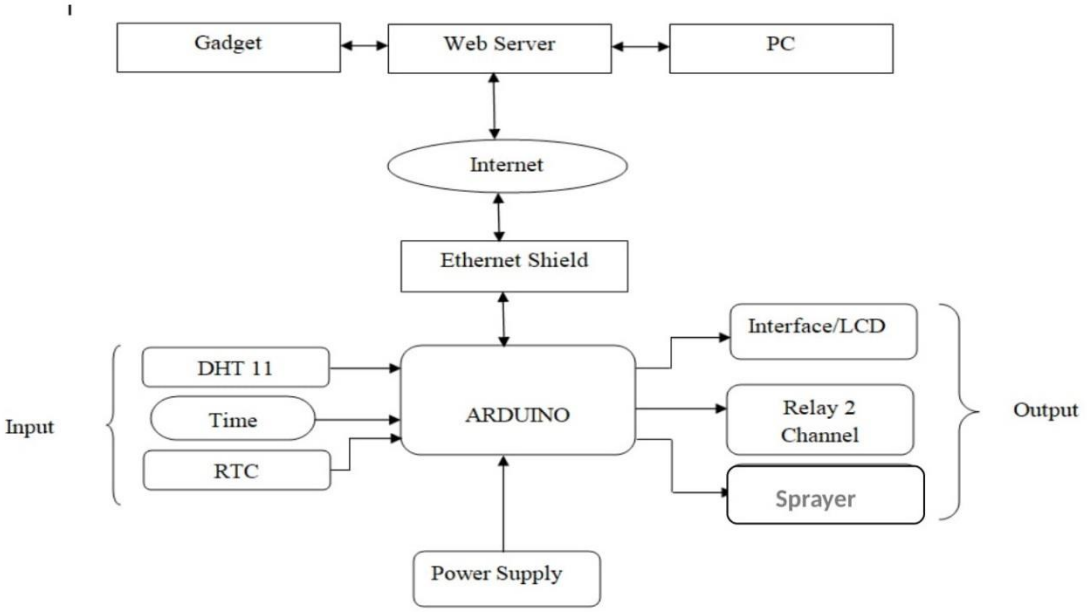

Figure.5 Schematic Diagram of Monitoring and Controlling System

KuiHe Yang Yixin Han Yanli Ma et al. in [6] has presented a paper on remotely monitoring and control of green house for mushroom based on Zig bee technology. This paper also shown the use of Internet of Things in crop growing. And how this system increases production and improves the automation of greenhouse, but also helps the farmers in monitoring the environmental parameters in crops yield by using mobile network on his phone or PC anytime. Zig Bee and 3G/4G network is used to give commands and data transmission.

Ziyu Wan et al. in [7] has purposed a paper on green house remote monitoring and control using ESP8266node microcontroller, the atmosphere temperature, humidity, carbon dioxide concentration and soil moisture were measured by sensors placed in the greenhouse. This sensor data is processed and sent to cloud and one of the platform IoT, Thing speak and Blynk platforms through wifi. This system also can change the environment conditions by turning on/off controllers devices remotely on phone using Blynk android application.

Yasas Pansilu Jayasuriya et al. in [8] has purposed a solution for controlling various parameters like air moisture and temperature measured by sensors.This measured values is recorded in remote server using Internet of things based weather stations. The algorithm for controlling of sprinkler, exhaust fan and lights through relays connected to microcontroller will be based on current values and already values saved in server. The air moisture is adjusted using water sprinklers and other ventilation openings.

Ibrahim Mat et al. in [9] has presented a Smart Mushroom House system using sensor units, gateway, actuators and controlling devices based on a Internet of things. Sensor data like temperature, humidity and Carbon Dioxide data are converted into digital form by sensor node and then further this sensors data is converted into a data stream in every 2minutes by Microcontroller for gateway. Gateway transmits data to the internet and server through WIFI network.

Kumar Sai Sankar Javvaji et al. in [10] has presented a solution for rain water harvesting and efficient use of water in a polyhouse and for control environment parameters like temperature, humidity, soil humidity, carbon dioxide, light ,tank level in poly house . Sensors data is analyzed on cloud server and messages are conveyed to the end users using GSM and Android phone application.

P. S. Asolkar et al. in [11]. Purposed a green house system for fruits growers that use Global system for mobile wireless technology. This system measure, display and adjust the temperature, humidity, soil moisture, and light strength and carbon dioxide gas. And sends data on user mobile phone through GSM modem.

Xia. Geng et al. in [12] has purposed a Moveable Greenhouse Environment monitoring system that uses internet of thing. Their system has four layers which uses mobile data acquisition which eliminates the use of multiple sensing nodes to greenhouse environmental parameters values and can automatically take pictures of the

agriculture crops. A Raspberry Pi and an Arduino chip fitted on mobile system is used in agriculture greenhouse environment for real time monitoring. Communication with Cyclic Redundancy Check and filtering algorithm were used to reduce data loss and improving data quality.

L. -D. Liao et al. in [13] purposed a paper in which he has designed and validated a multifunctional android based intelligent home control and watching system Their system is based on web server at an Arduino microcontroller board with Internet connection that helps device control through an Android-based mobile application, the system can be managed by a touch display.

2.5. PLC and scada based automatic monitoring and control

Programmable logic controllers are made for controlling industrial processes. It has dedicated module space for connecting various inputs and outputs modules that can control and monitor industrial processes. Figure 6 shows the parts of this system. Many features can be added as per the demand such IOT and scada module controllers are small digital microprocessor based devices which has input and output capabilities it has preprogrammed control logic for controlling only one or two parameters. they are available in online market for use in small isolated houses has ability to read any one or two parameter such as temperature ,humidity ,pressure , air flow and can control these parameters depends upon the slave device connected to it such as ,fan, air conditioners. Lamps etc. Neena s.watkar et al. in [14**]** has presented paper to reduce human efforts required for the mushroom cultivation plant by automation to measure and controlling the crop room environment parameters using PLC Naxgene 1000 for controlling whole system .Temperature transmitter is used to measure the temperature. Electrically Controllable valve for sprinklers, exhaust fan for air circulation is used and gets turned ON when the temperature crosses set point by the PLC. By using the output signals given by various sensors used in plant, PLC will automatically adjust the conditions for good growth of plants.

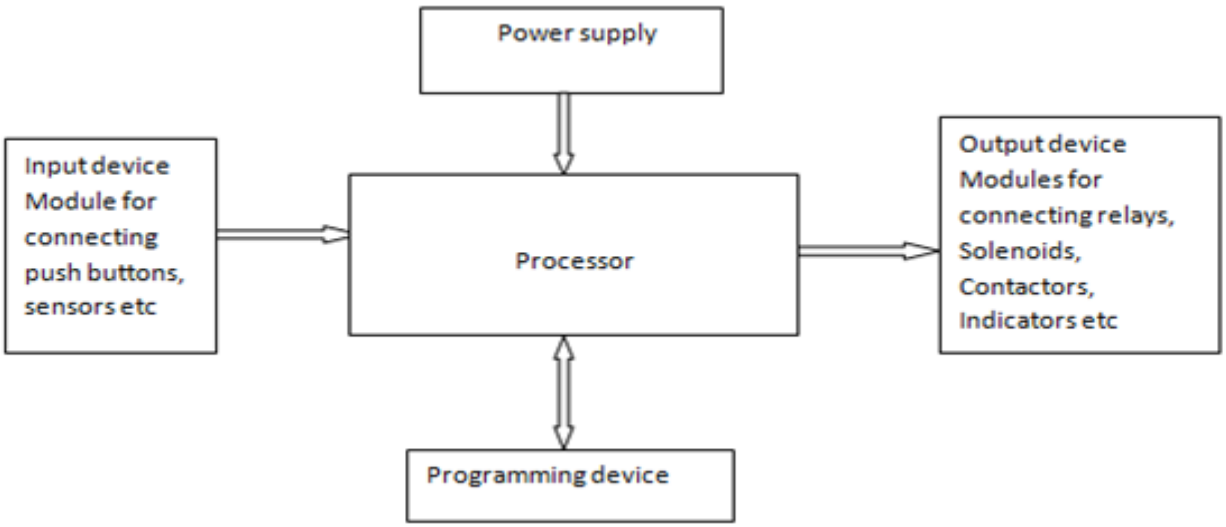

Figure 6. Internal architecture of PLC

3. Comparison of Different automation techniques for mushroom Cultivation.

Comparison analysis of different automation techniques is written in Table 1

Table 1: Comparison of Different automation techniques for mushroom Cultivation

Type of automation	**Advantages**	**Disadvantages**	**Ability of function extension and interface**	**Data information and interface for user**	**Appropriate application**
Digital Thermostat controllers	Portable, cheap and easy to install ,	Can control only one or two devices	No port for extension and programming	7 segment display	Single room

Microcontroller based automation without wireless communication	Simple to install, maintain ,cheaper, less complex	Can be used for one room after that sensor wire increases result in wrong parameter measurement.	It has usb port for programming and function extension	LCD and buzzer can be installed and programmed	Small single room farms
IOT with Bluetooth ,wi fi, gsm etc	Costlier than microcontroller ,complex ,	Complex and lengthy system, communication link is required.	It has USB port for programming and function extension	Smartphone,, pc	When farmer is far away from mushroom farm
PLC and SCADA	Sensors and modules are easily available ,	Sensors and actuators and programmers are costly	It has tailored made input and output modules available for interfacing.	LCD and computer, Smartphone	Can be controlled from pc, Smartphone etc

4. Research gaps and future suggestions

1. Literature reviews indicate that formula for rating of air conditioners and humidifiers is not calculated for farm size.

2. Time of ventilation i.e. turns on time and rating of exhaust fan is not calculated as per size of farm and $c0_2$ concentration in farm during mushroom fruiting season.

3. Effects of insects, flies and mosquitoes in contaminating and their control are not touched in any of the paper.

4. Role of wall insulation of farm is not shown in maintaining the environment of mushroom farm is not shown.

5. Design of system can be improved and made user friendly and water proof for effective working.

5. Conclusion:

This paper presents different automation techniques for different mushrooms growing farms applications which are discussed along with their parts and working in various Journals such as IEEE , Elsevier, SCI and other international journals .These techniques is studied for better selection of automation for farmers as given in appropriate application column in the table according to their needs such as initial investment , complexity , sensor information availability, ease of operation and size of their farm. In addition to this Research gaps is also investigated for future research in this topic.

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