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Design and develop the Smart Multisensor data fusion system to monitor the Ambient temperature

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ABSTRACT: The main objective of this work is to design and develop multisensor data fusion system to monitor the ambient temperature of the tissue culture laboratory and the temperature of the process industries. In the industrial field, long running of the equipment easily leads local temperature of the equipment to rise. This is a security risk. For this problem, we have designed a temperature monitoring system. In this we have used the different temperature sensors like LM35, LM335 and thermister, these multiple sensor are exposed to the environment for the measurement of the temperature, the sensor data is sent to the fusion center and the fusion center gives the average data from the multiple sensor data, then the fused data is sent to the controller, if the fused data i.e., temperature exceeds the threshold then the control of the room temperature by setting the Air condition to the required level of temperature is done by the controller.

Key words: Data Fusion, temperature sensor, LM35, Ambient temperature.

INTRODUCTION

A greenhouse structure creates a controlled environment to grow plants. Greenhouse is a building where plants are grown in large scale by setting some parameters like temperature, humidity and light that can be adjusted to the needs of growth and development of plants. Plants grow well only under nutritionally and environmentally supportive conditions. They will not reimburse for poor growing conditions like improper temperature, inadequate light or pest problems. Because the temperature and humidity of greenhouse must be constantly monitored to ensure optimal conditions, there should be a system to gather the data of temperature and humidity continuously. One of the pivotal features of a greenhouse is temperature. All plants have maximum, optimum and minimum temperature limits. The limits are cardinal temperature points. Optimum temperature range is very important.

Low temperature affects several aspects of crop growth such as survival, cell division, photosynthesis, water transport, growth and finally yield. They can result in poor growth. Photosynthesis slows at low temperatures. Since Photosynthesis is slowed, growth is slowed and this results in lower yields.

High temperatures induce increased respiration sometimes above the rate of photosynthesis. For growth to occur photosynthesis must be greater than respiration. Consequently for the healthy plant growth it is required to maintain optimum temperature. The existing systems use a single temperature sensor to monitor the temperature in green house. Employing single sensor has some drawbacks. The main objective of this project is to design and develop a system to monitor the temperature in the process industries which is continuously monitored and controlled using multiple sensor arrays.

II. METHODS

The objective of the proposed work is to design and develop a low cost, accurate and highly efficient smart system for monitoring and controlling the most common physical parameter temperature in various process industries. As it is required to maintain an accurate temperature in these industries which is not possible with a single sensor.

We are designing a smart system using multiple sensor arrays which monitor's and controls the temperature and provides required output with the help of LCD and buzzer.

In any process industry it is required to continuously monitor and control temperature. Conventional sensing systems use a single sensor to convert a measurand into an electrical signal. Such a system is wholly dependent on the single sensor and novel online monitoring system that employs multiple sensor array which senses the change in physical parameters so as to provide the degree of safety and reliability in process industries.

The block diagram of online monitoring and control of process parameters using multiple sensor array is shown in the above Fig. 1. The system consists of multi-sensors of same category which is used to measure temperature for example LM35, thermistor, LM335 and fusion units to fuse all sensor outputs, comparators, DAC, micro-controller and LCD display .The different sensor outputs are fed to fusion unit 1, fusion unit 2, fusion unit 3 respectively. The output from fusion unit with reference voltage that is generated by a software algorithm and converted to an analog voltage through DAC. The output from comparator is fed to microcontroller. The microcontroller does the fusion based on comparator output. LCD, buzzer and air conditioning circuit for maintaining the temperature are interfaced with the microcontroller. The LCD displays the various parameters being measured. The buzzer buzzes when the process parameters have exceeded the reference value and the air condition is maintained at the required temperature.

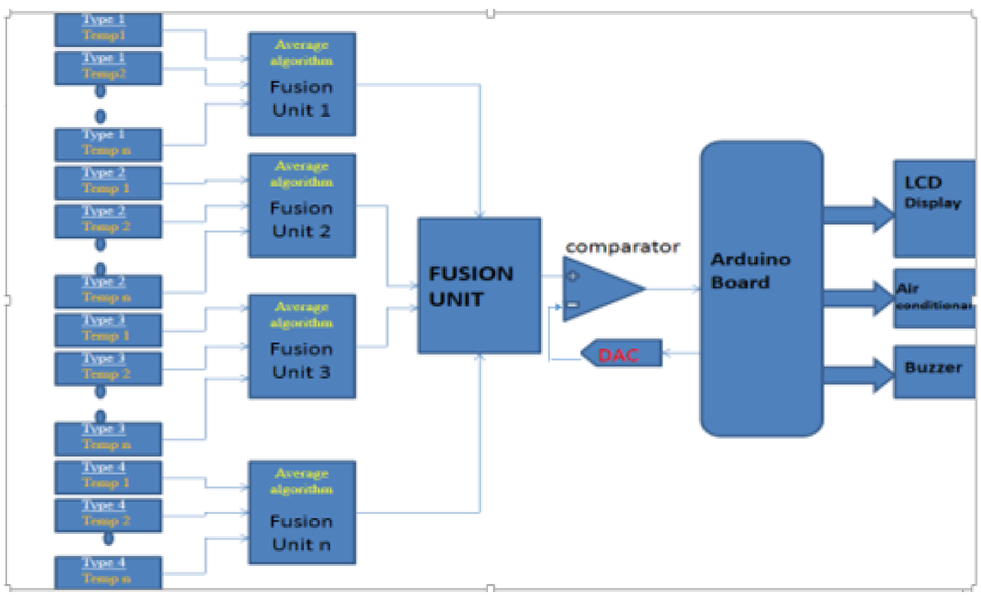

Fig.1. Block Diagram of implementation for temperature sensors.

The proposed system consists of multi-sensors of same species /family that is temperature. The temperature sensors used for the proposed work are, LM35, LM335 and thermistor which are categorized as type 1(first family of sensors, example: LM35), type 2(second family of temperature sensors, example: LM335) and type 3 (third family of sensors, example: Thermistor). The details of the type sensor is as given in Table.

Table 1. Sensor Type and Name.

S. NO	Sensor Type	Sensor name
1.	Type- 1	LM35
2.	Type-2	LM335
3.	Type-3	thermistor

Fusion of multiple sensor data is done in the fusion center (unit) in order to fuse the sensor data using fusion algorithm (average algorithm) from the various sensor outputs. And further the outputs from the fusion units 1, 2 3…. n with average algorithm becomes input to the fusion unit and the output from the fusion unit is given to the comparator which compares the output from fusion unit and the corresponding reference voltage. Comparator checks for 3 different conditions and they are:

(i) Less than the threshold value.
(ii) Equal to the threshold value.
(iii) More than threshold.

If the value obtained is less than threshold then no value is observed or the output is zero. And only monitoring is done.

If the value obtained is equal to threshold the output will be non-zero and controlling is done. If the value obtained more than threshold then monitoring and controlling is done interfacing is done to the air condition.

The Fig. 2 shows the implementation of the proposed work on the breadboard, the multiple temperature sensors are placed on breadboard and the sensors are sensing the ambient room temperature the continuously the sensed data is sent to the aurdino board and the sensor data is continuously displayed on the monitor of the PC.

If the sensor data is exceeding the threshold value then the required control action is taken by the controller.

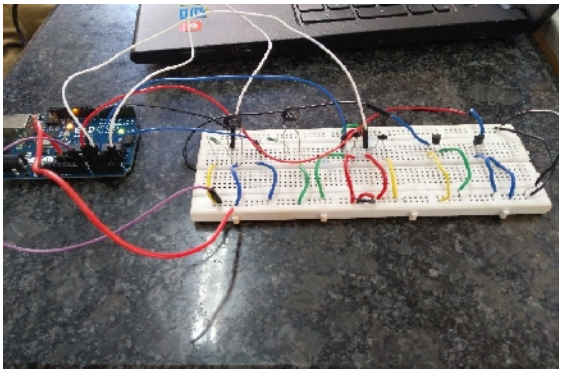

Fig. 2. Bread board implementation of temperature sensors using arduino board.

III. RESULTS AND DISCUSSION

We have observed the temperature sensor output at different interval of time and the output produced from the sensor at different interval of time is different voltages, The temperature sensors LM35, LM335 and thermistor readings at various instant of time is given in the Table 2and Table 3. We observed the temperature sensor output at different interval of time for different sensor type as per the Figure.

Table 2: Sensor Readings of one LM35, one LM335 and one Thermistor Temperature Sensor.

Temperature in degree Celsius	Time	Lm35 In Volts	Lm335 In Volts	Thermistor In Volts
26.50°C	8:00 AM	0.265	0.31	0.32
26.75°C	9:00 AM	0.2675	0.34	0.34
27°C	10:00 AM	0.27	0.33	0.33
27°C	11:00 AM	0.27	0.32	0.35
27.50°C	12:00 PM	0.275	0.30	0.36
28°C	1:00 PM	0.28	0.31	0.38
28.50°C	2:00 PM	0.285	0.32	0.38
28°C	3:00 PM	0.28	0.33	0.36

Table 3: Readings of two LM35, two LM335 and two Thermistor Temperature Sensors.

Temeperature in degeree celcius	time	Type1 Lm35(1) In Volts	Lm35(2) In Volts	Type2 Lm335 In Volts	Lm335 In Volts	Type3 Thermistor In Volts	Thermistor In Volts
26.50°C	8:00 AM	0.265	0.264	0.30	0.31	0.32	0.35
26.75°C	9:00 AM	0.2675	0.2675	0.35	0.34	0.34	0.34
27°C	10:00 AM	0.27	0.26	0.33	0.33	0.33	0.36
27°C	11:00 AM	0.27	0.27	0.32	0.32	0.35	0.37
27.50°C	12:00 PM	0.275	0.276	0.31	0.30	0.36	0.38
28°C	1:00 PM	0.28	0.29	0.31	0.31	0.38	0.37
28.50°C	2:00 PM	0.285	0.284	0.32	0.32	0.38	0.37
28°C	3:00 PM	0.28	0.28	0.33	0.33	0.36	0.36

CONCLUSION

In this work we have developed the multisensor data fusion system so as to monitor the ambient temperature of the room for the tissue culture laboratory. The various temperature sensors belongs to different ranges are exposed to the room for the measurement of the temperature, the sensor data is sent to the fusion center and the fusion center gives the average data from the multiple sensor data, then the fused data is sent to the controller, if the fused data i.e. temperature exceeds the threshold then the conrol of the room temperature by setting the Air condition to the required level of temperature is done by the controller.

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