A GREEN HOUSE SYSTEM BASED ON CPLD

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ABSTRACT
The important part of the agriculture and horticulture sectors is efficient production. For optimum plant growth, improved yield of crops and for efficient use of water and other resources appropriate environmental conditions are necessary. Many researchers have been carried out to develop a greenhouse monitoring system. The existing greenhouse monitoring systems are costly, bulky and difficult to maintain. This paper presents an attempt which has been made to design a CPLD(Complex Programmable Logic Device) based monitoring system for green house, for real time monitoring the climatic parameter which directly or indirectly affect the growth of green house plant. The proposed system continuously monitors and controls temperature and soil moisture in green house to ensure it remains at preset level. For the hardware Implementation of the controller circuit CPLD is used. The controller circuit has been programmed using Verilog. The design is simulated using Modelsim for Model Technology and Xilinx tool is used for implantation. The developed system is cost effective, simple and easily installable.

Keywords:
Green house, CPLD, Temperature sensor, Soil moisture Sensor, Verilog.

INTRODUCTION

We live in a world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. One such field is that of agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. Greenhouses form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum produce. Automating a greenhouse envisages monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Automation is process control of industrial machinery and processes, thereby replacing human operators.

The objective of this project is to design a simple, easy to install, CPLD-based circuit to monitor and record the values of temperature and soil moisture of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. The technology used is a low power, cost efficient CPLD which communicates with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a Fans, Water pumps, dripper respectively according to the necessary condition of the crops. Also, the use of easily available components reduces the manufacturing and maintenance costs. The design is quite flexible as the software can be changed any time. It can thus be tailor-made to the specific requirements of the user.

LITERATURE SURVEY

FPGA implementation for humidity and temperature remote sensing system
Author: Wael M El-Medany
Hardware design and implementation of a remote sensing system for humidity and temperature using FPGA for the hardware implementation and GSM for remote monitoring.24 hours real time remote monitoring for temperature and humidity. CPLD can be used as the target technology.

FPGA based real time monitoring system for agricultural field
Author: M.Dinesh, P.Saravanan
Continuous monitoring of temperature, soil moisture, light and level of CO2 using FPGA. Real time monitoring and low cost. PLD is a good option for technology development and implementation

Soil moisture sensors

Author: Fedro S.Zazuepa and Jiannong Xin
Soil moisture sensors is used to measure the resistivity between electrodes in a soil or to measure the resistivity of a material in
equilibrium with the soil. Theoretically it can provide absolute soil water content.
A precision temperature controller using embedded systems
Author: Aakanksha Pimpalgaonkar, Mansi Jha, Nikitha shukla, Kajal Asthana
To design and implement an automated temperature control system using embedded system. Controlling the temperature of the surrounding environment by using temperature sensor LM35 IC.
The application of soil temperature measurement by LM35 temperature sensor
Author: Cuihong Liu, Wentao Ren
Researchers the applicability of LM35 temperature sensor in soil moisture testing field. It provides high reliability and is low cost.

SYSTEM ARCHITECTURE

The above figure represents the block diagram of greenhouse monitoring system. The control unit is CPLD (XC9572XL). We use temperature sensor and soil moisture sensor to control the parameters and monitoring it.
The communication between
temperature sensor and control unit is through RF module (RF TX and RF RX).The received data is sensed and to reach the optimal condition fans are being used i.e. if the temperature is less, outlet fan turns ON and if temperature is more, inlet fan turns ON. If the water content in the soil is less then automatically water will be sprinkled.

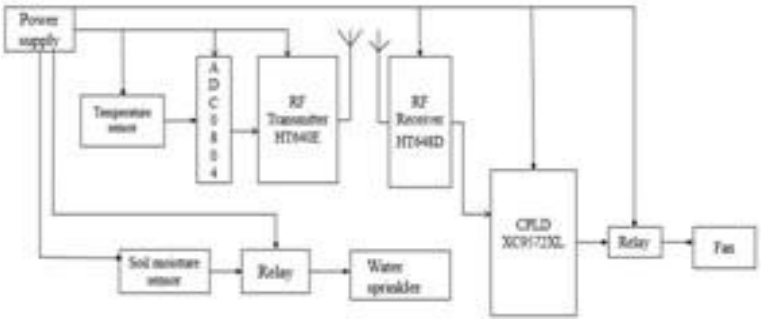


Fig 3.1 Block diagram of proposed system

Temperature sensor (LM 35)
The LM35 series are precision integrated circuit temperature sensor, whose output voltage is linearly proportion to Celsius (centigrade) temperature. If the temperature exceeds beyond the limit set then a fan will be automatically switched ON as a coolant to reduce the temperature.
When it reaches the desired temperature the fan will be switched OFF automatically with
the help of relay. But if temperature decreases below the optimum temperature
Soil moisture sensor
Soil moisture sensor checks the water content in the soil. If the water level in the soil decreases below the threshold level, the sensor send signal to the water sprinkler through relay to sprinkle water. When the sensor senses the threshold value of water level in the soil, it automatically switches OFF the sprinkler.
ADC-0804
It is a very commonly used 8-bit analog to digital convertor .The step size at 5V is 19.53mV (5V/255) i.e., for every 19.53mV rise in the analog input, the output varies by 1 unit. The output from sensors are converted from analog to digital form.
RF module
RF module comprises of RF transmitter and an RF receiver. The Transmitter- receiver pair operate at a frequency of 433/315 MHz. The RF Transmitter receives serial data and transmit it wirelessly through its antenna**.** RF module is often used with a pair of encoder/decoder. The encoder (HT640E) is used for encoding parallel data for transmission fed while reception is decoded by a decoder (HT480D).

CPLD(XC9572XL)

Complex Programmable Logic Device (CPLD) is a Programmable Logic Device with complexity between that of PALs and FPGAs. Non-volatile configuration memory. Unlike many FPGAs, an external configuration ROM isn't required, and the CPLD can function immediately on system start up. It acts as a control unit. It receives signal from the RF receiver and controls the temperature by turning ON/OFF the fan through relay.

Relay

A relay is an electromagnetic switch operated by a relatively small electrical current that can turn on or off a much larger electrical current. Relay bridge the gap, making it possible for small currents to activate larger apparatus. They can operate as a switch (on/off) or as an amplifier.

FLOW DIAGRAM

Step 1: Start
Step 2: Specify the inputs and outputs
Step 3: If enable is low, then both inlet and outlet fans are OFF
Step 4: If enable is high, then it checks two conditions whether

i. The temperature is less than 25°C or
ii. The temperature is greater than 45°C

Step 5: If the temperature is less than 25°C then the outlet fan will turn ON or if the temperature is greater than 45°C then the inlet fan will turn ON.
Step 6: If the temperature is in between 25°C and 45°C then both the fans are turned OFF.
Step 7: End

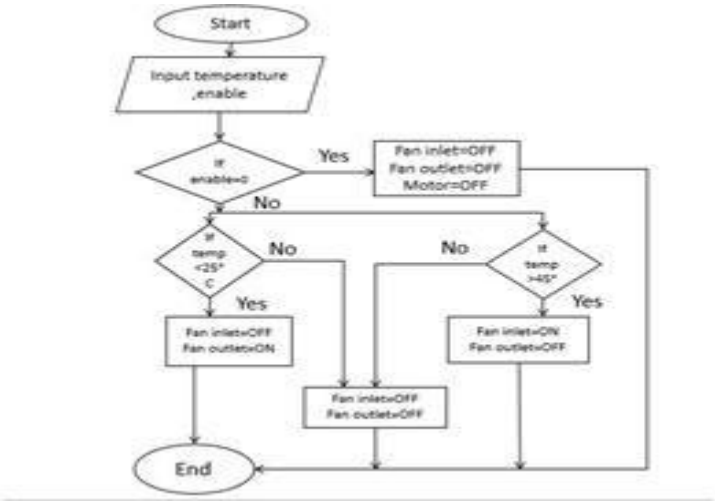


Fig 4.1. Flowchart of proposed system

RESULTS AND DISCUSSIONS

TEMPERATURE SENSOR

Considering the optimum temperature between 25° C to 45° C. Temperature sensor output

Table 5.1 Output of Temperature sensor

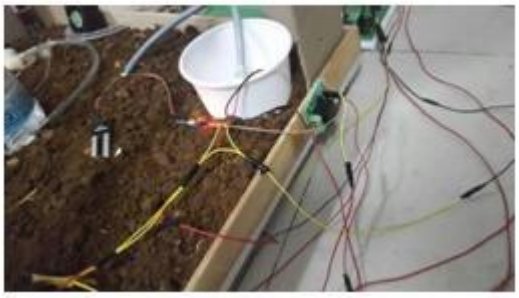
Temperature	Inlet Fan	Outlet Fan
Less than optimum temperature	OFF	ON
Optimum temperature	OFF	OFF
More than optimum temperature	ON	OFF

Fig 5.1 Output of temperature sensor

SOIL MOISTURE SENSOR

Considering an optimum moisture of 80% Soil Moisture sensor output

SL no	Soil moisture	Output
1	Less than 80%	Water sprinkler will be ON
2	Greater than or equal to 80%	Water sprinkler will be OFF



Soil moisture is normal
Relay is OFF
Motor is OFF

Soil moisture is normal
Relay is ON
Motor is ON

Fig 5.2 Output of soil moisture sensor

CONCLUSION

A step-by-step approach in designing the CPLD based system for measurement and control of the two essential parameters for plant growth, i.e. temperature and soil moisture has been followed. The results obtained from the measurement have shown that the system performance is quite reliable and accurate.

The system has successfully overcome quite a few shortcomings of the existing systems by reducing the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment.

The continuously decreasing costs of hardware and software, the wider acceptance of electronic systems in agriculture, and an emerging agricultural control system industry in several areas of agricultural production, will result in reliable control systems that will address several aspects of quality and quantity of production.

Further improvements will be made as less expensive and more reliable sensors are developed for use in agricultural production. The system can be further improved to monitor and control other parameters like humidity, illumination, soil pH etc. System can be programmed to indicate if fault is generated. Facilities for user can be increased such as one can set the offset of the offset of the temperature and humidity. Time bound administration of fertilizers, insecticides and pesticides can be introduced.

REFERENCES

[1]. Wael M El-Medany, "FPGA Implementation for Humidity and Temperature Remote Sensing System", Department of communication and electrical engineering, University of Bahrain, 32038 Bahrain, 2008

[2]. M.Dinesh, P.Saravanan, “FPGA Based Real Time Monitoring System for Agricultural Field”, Department Of Electronics and Communication, 2011
[3]. Aakanksha Pimpalgaonkar, Mansi Jha, Nikitha shukla, Kajal Asthana, “A precision temperature controller using embedded systems”, Department Of Electronics and Telecommunication, 2013
[4]. Cuihong Liu, Wentao Ren,” The application of soil temperature measurement by LM35 temperature sensor", Shenyang Agricultural University, China, 2011
[5]. O. Korner , H. Challa, “Design for an improved temperature integration concept in greenhouse cultivation”, Farm Technology Group, Department of Agro technology and Food Sciences, Wageningen University, Mansholtlaan 10, 6708 PA Wageningen, The Netherlands, 2002
[6]. Nonel Thirer and Igor Uchansky, “An FPGA based computer system for Greenhouse”, Athens Journal of sciences, 2013.
[7]. Domingo Gomez-Melendez1, Alvaro Lopez-Lambrano, Gilberto Herrera- Ruiz, Carlos Fuentes, Enrique Rico-Garcia, Carlos Olvera-Olvera Daniel Alaniz-Lumbrerasc, Teobaldis Mercado Fernandez and Sven Verlinden, “Fuzzy irrigation greenhouse control system based on a field programmable gate array”, Division of Plant and Soil Sciences, West Virginia University, Morgantown, WV 26506, US, 2011