International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 6 Issue: 4 283 - 285

GSM based Intelligent Climate Control System for Greenhouse using FPGA

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Abstract- In this paper we proposed a model of remote monitoring system for greenhouse. In green house the most important parameters are temperature & humidity, we monitored these two parameters. The model consists of FPGA Spartan3 as a controller, signal conditioning circuits, relays & for wireless communication GSM modem is used. The programming is done in VHDL language & simulated using Xilinx ISE simulator.

Keywords: *Greenhouse, GSM, FPGA, AT Commands, SMS, Monitoring, Control.*

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I. INTRODUCTION

Greenhouses are increasingly important in the food supply of high latitude countries. In our country also the greenhouses are rapidly increasing particularly for flowers, fruits & vegetables. The closed environment of a greenhouse has its own unique requirements, compared with outdoor production. Pests and diseases, and extremes of heat and humidity, have to be controlled, and irrigation is necessary to provide water. Significant inputs of heat and light may be required, particularly with winter production of warm-weather vegetables. Special greenhouse varieties of certain crops, like tomatoes, are generally used for commercial production. [3]

The purpose of altering the environment is to provide a constantly controlled environment where plants can be grown at their optimum, not just to avoid extremes in the weather.

So, we are proposing a system which monitors the greenhouse parameters remotely.

II. PAPER DEFINATION / SPECIFICATIONS

In our paper "GSM based Intelligent Climate Control System for Greenhouse using FPGA" we have designed a remote monitoring & control model.

The parameters in the greenhouse are collected with the help of sensors located at the different locations and analyzed by controller. Then according to the collected parameters the action is taken like decrease the temperature if it has crossed the threshold level or to give water to the crops. Then the same collected data & taken action is conveyed to the owner via SMS. [4] [5]

Also the owner can send SMS to the system to know the current status of that location or to change the threshold levels of the parameter.

A. Specifications:-

Input Voltage :- 5V Battery
Input to System :- SMS
Number of Sensors :- 3
(Can be increased up to 8)
Number of Relays :- 3
(Can be increased up to 5)
GSM Module - SIMCOM
(Other module can be used)
Clock Mode :- 24 Hour Mode
SMS Billing :- At Low Cost
Security :- Authentication by Login & Password.

III. BLOCK DIAGRAM

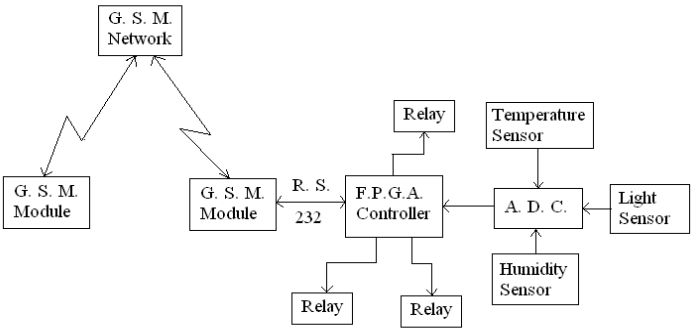

Figure: 1 Block Diagram

A. Block Diagram Description

1) FPGA:

In our model the FPGA used is Xilinx Spartan3 FPGA. The FPGA acts as a main controller of the system. Its main function is to collect the parameters from sensors analyze them & to take control action according to the analysis either to give water to the plants in the greenhouse or to switch on ventilation system if temperature is increased. [6], [7]

Its main function is also to create SMS according to the analysis & send it to the user. If user wants to change the parameter threshold then user can send the SMS & can change the parameter threshold.

2) GSM Modem:

The GSM modem used is SIMCOM's GSM Modem. It is serially interfaced with the Spartan3 FPGA. [4]

3) ADC:

ADC used is an eight channel ADC (0809), so that in future we can increase the number of parameters up eight. It converts the parameters analog values into the digital & gives to the FPGA.

4) Relay:

The relay used are the solid state relay, they requires 4.5V, 2mA current i.e. they consumes very low power & photo coupled SSR(Solid State Relay) avoids loading effect.

5) Sensors:

In this model we have used three sensors namely

Temperature sensor –

LM 35 -The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. Its features make the system low cost.

- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain.
-

Light sensor-

LDR- NORP12- Light-dependent resistances (LDR) are cheap light sensors. The light dependent resistor (LDR) is a sensor whose resistance decreases when light impinges on it. This kind of sensor is commonly used in lighting control applications.

Humidity sensor –

HIH 3610 - With a typical current draw of only 200 mA, the HIH-3610 Series is ideally suited for low drain, battery operated systems.

B. Remote Monitoring Process

1. Collecting data
2. Transmitting collected data through a Communication network
3. Receiving data
4. Processing data. [5]

C. Specifications of GSM

		Frequency Range
1.	Uplink	890-915 MHZ
2.	Downlink	935-960 MHZ
3.	Duplex distance	45 MHZ
4.	Carrier separation	200 KHZ
5.	Modulation	GMSK
6.	Air transmission rate	270 KBPS
7.	Access method	G.S.M.

IV. AT COMMANDS

1. +CPMS Preferred Message Storage
2. +CMGF Message Format
3. +CSMP Set Text Mode Parameters
4. +CMGS Send Message
5. +CMGW Write Message to Memory
6. +CMGC Send Command
7. +CMGD Delete Message
8. +CMGR Read Message
9. +CNMI New Message Indications to TE. [4]

V. FLOW CHART

Flow chart of the system is as shown below, first we are initialing the system set points then serial communication & GSM modem. After initialization the current parameters of Greenhouse are transmitted then checking for new message. If new message comes then it checks for authentication if it is not authenticated then it is strictly deleted & if it is authenticated then stored in memory for further processing, after the processing stored message is deleted & according to the message the action is taken & whatever the action is taken is also conveyed to the user by just sending the SMS.

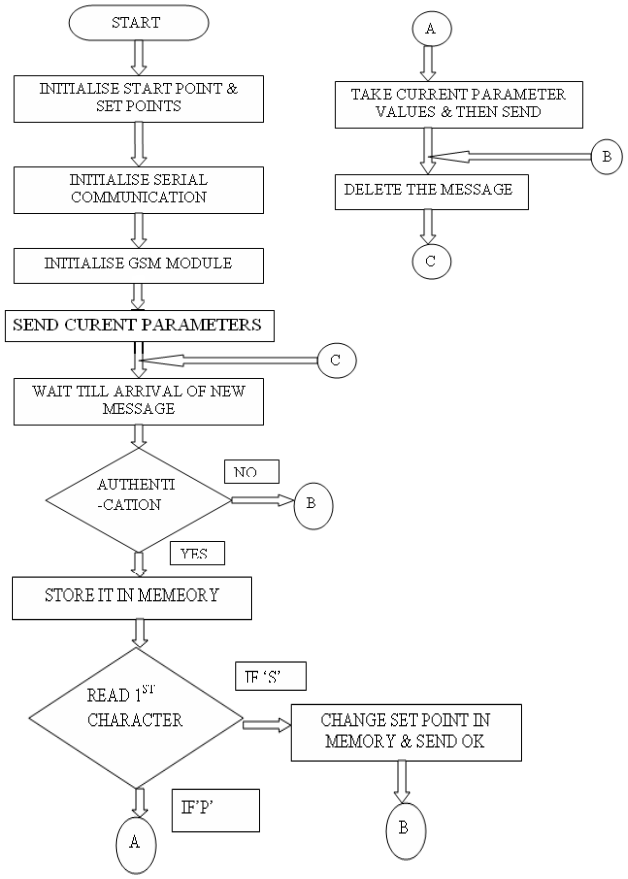

Figure 2: Flow Chart

The code is written in VHDL language & simulated with the help of Xilinx ISE 7.1 Simulator. Authentication & security to the system is given in software.

VI. CONCLUSION:

In this paper we are providing a remote monitoring system for Greenhouse using GSM & FPGA.

The main aim of the greenhouse is to increase is to yield. Yield of the greenhouse depends on the environment inside the greenhouse; if environment inside the greenhouse is maintained properly then it will result in increased yield i.e. it will help to increase the profit from the greenhouse.

The presented model is battery operated & also it operates on low power i.e. there is no extra power consumption.

Also the system is flexible i.e. we can change the threshold values of the parameters as per the season or outside environment of the greenhouse.

FUTURE SCOPE

In this system we are communicating to the user & vice versa by using only SMS, in future the user & system can communicate with each other via internet i.e. GPRS can be added to the system. Also by making Client Server Architecture with the help of website centralized control of many greenhouses is possible.

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