Intelligent Crop Management System for Greenhouse Environment

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Abstract: ***In this project my aim is to develop a central monitoring and control system for the multiple Greenhouses. This can be managed from one central location wirelessly using GSM module. No expert person presence is required when new Crop set points needs to set. Simply user from remote location can select the crop from system database and all related set point would be selected from the system database and sent through GSM to the selected Greenhouse. Hence we are removing the dependency of expert. Multiple crops set point like temperature, humidity, sunlight, etc. suitable for the particular crop can be set from the central unit and sent to controller through GSM module. Another interesting point in my project is that it has a generic architecture which can be applied for many other small/medium automation applications.***

Keywords: GSM, Green House, Generic, Intelligent, Crop

1. Introduction

From last few years, there has been a popularity rise of computers for control of greenhouse. The main improvement in computer based climate control is found in data logging. Greenhouse cultivation represents a very important role in modern agriculture. As the greenhouse usually equips with various high-tech equipments, management tend to be very complex.

A fully automated greenhouse control system brings obvious benefit such as labor saving, but far more importantly, it enables improved quality of produce and information gathering that will make difference between earning a profit and substantial losses. Environment condition has been significant effect on the plant growth. The greenhouse structure represents both the barrier to direct contact to external environment and the containment of the internal environment to be controlled.

The covering material by design allows for maximum light penetration for growing crops. All plant required certain for their proper growth. Greenhouses can be divided into glass greenhouses and in plastic greenhouses. Commercial glass greenhouses are often high tech production facilities for vegetables or flowers. The glass greenhouses are filled with equipment like screening installation, heating, cooling and lighting and may be automatically controlled by computer. The glass used for greenhouse works as selective transmission medium for different spectral frequencies and its effect is to trap energy within the greenhouse, which heats both the plants and ground inside it. This warms the air near the ground and this air is prevented from rising and flowing away. This can be demonstrated by opening a small window near the roof of a greenhouse: the temperature drops considering. This principle is the basis of auto vent automatic cooling system. Greenhouses thus work by trapping electromagnetic radiation and preventing convection. The goal for this project is to develop a central monitoring and control system for multiple greenhouses. Another interesting point in my project is that it has a generic architecture which can be applied for many other small/medium automation applications.

2. Literature Review

Greenhouse automation solution which senses, processes and store temperature values manage temperature by comparing the measured values with the expected ones and take action if it is necessary. The solutions aims are flexibility, maintainability and usefulness. Following terms associated with it and infused into the system.

2.1 Temperature Sensor :LM35

Figure 1: LM35 Temperature Sensor

The Temperature sensor LM35 is as shown in figure 1. The LM35 series are precision integrated temperature sensor, whose output voltage is linearly proportional to Celsius temperature. The LM35 has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain its equivalent centigrade scaling. The LM35 does not require any external calibration or trimming to provide accuracy of +/- 25C at room temperature.

Features:

1) Calibrated directly in Celsius.
2) Low impedance output.
3) Suitable for remote application.

2.2 The Light Sensor: LDR

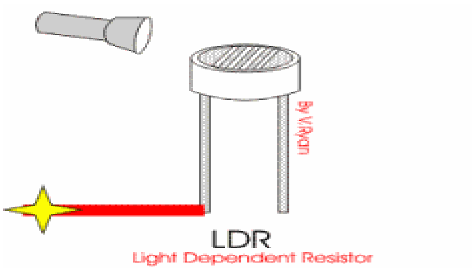


Figure 2: LDR Light Sensor

The light sensor is made using an LDR (Light Dependent Resistor).The resistance of the LDR varies according to intensity of light falling on the surface. When the torch is turned on , the résistance of the LDR falls ,allowing current to pass through it as shown in figure 2.

Features:
1. Wide spectral response.
2. Low cost.
3. Wide ambient temperature range.

2.3 Humidity Sensor:SY-HS-220

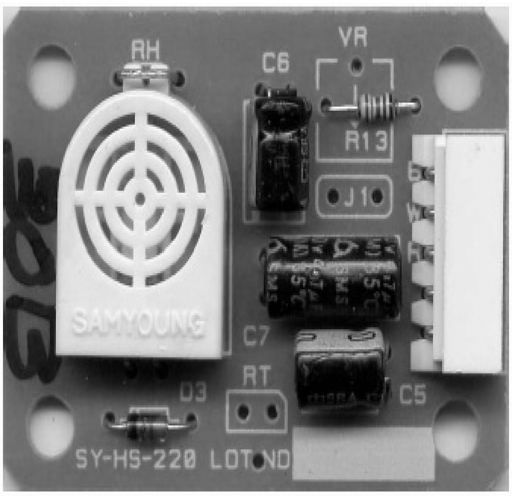


Figure 3: SY-HS-220 Humidity Sensor

The humidity sensor SY-HS-220 can operate up to the range of 95% RH (Relative Humidity). Humidity sensor module itself contain the signal conditioning unit and the voltage out can take out through the connectors.

We know that the level of humidity in the air is also a function of temperature. Excess humidity can cause growth of fungus. Too little humidity can cause static discharge or accumulation of unwanted dust, contributing to allergies.

Here we use a humidity sensor known as SY-HS-2 and the module is SY-HS-220 series which produces more accurate and linear voltage output. This is a polymer humidity sensor.

Features:
1) Humidity sensor module with voltage output
2) Wide temperature compensation range
3) High reliability and long term stability
4) Linear dc voltage output for humidity range
5) High sensitivity and low hysteresis
6) Compact size and cost effectiveness

2.4 GSM Modem

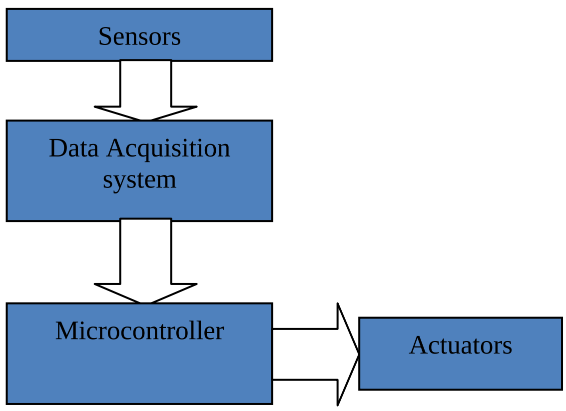
GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, Pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Pico cells are small cells whose coverage diameter is a few dozen meters, they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells. Cell horizontal radius varies depending on antenna height, antenna gain and propagation conditions from a couple of hundred meters to several tens of kilometres. The longest distance the GSM specification supports in practical use is 35 kilometres (22 mi). There are also several implementations of the concept of an extended cell, where the cell radius could be double or even more, depending on the antenna system, the type of terrain and the timing advance. The modulation used in GSM is Gaussian minimum-shift keying (GMSK), a kind of continuous-phase frequency shift keying. In GMSK, the signal to be modulated onto the carrier is first smoothed with a Gaussian low-pass filter prior to being fed to a frequency modulator, which greatly reduces the interference to neighbouring channels (adjacent-channel interference).

3. System Design

The hardware unit of the prototype of the system is represented by the block diagram blow. It contains avr microcontroller as the main processing unit.

3.1 Generic Architecture

It has a generic architecture which can be applied for many other small/medium automation applications. Block diagram of generic architecture is shown below.



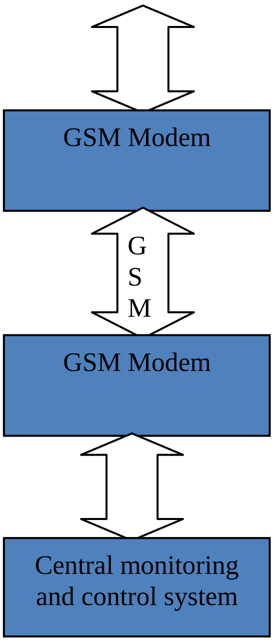


Figure 4: Generic architecture

The Generic architecture has sensors, data acquisition system, microcontroller, two GSM modem and central monitoring and control system. It can be controlled using Software Application from any location. Here I am going to develop the Generic architecture for Green house environment. The parameters for the particular crop can be set from any location using Software Application and sent to the central GSM modem to the GSM modem at green house wirelessly. It can also be applied for other small/medium automation system.

3.2 Proposed Architecture

In this proposed architecture there are two modules. One module is at the central location side and one is at the green house location side.
In module one there are GSM modem and one central software application. Proposed architecture is shown below.

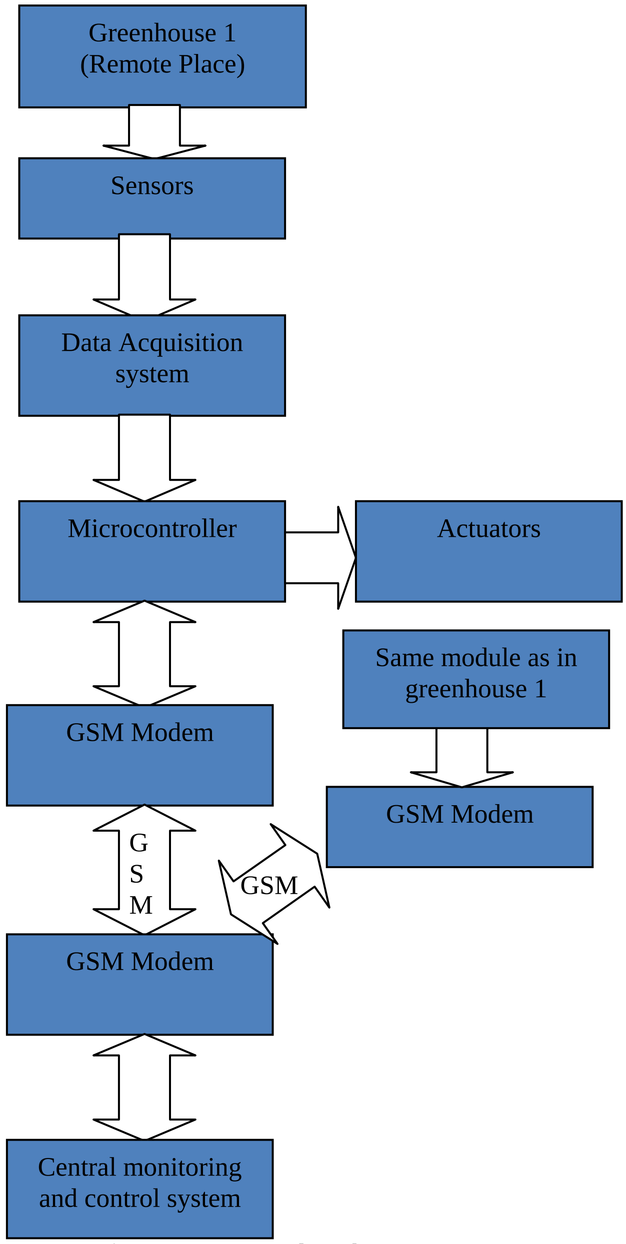


Figure 5: Proposed Architecture

Steps for module one is written below

1 – Selects the Green house name/number
2 – Select the new Crop value
3 – Click on Apply button of software so selected Crop set point values for all parameter would be transmitted to selected Green house

In module two there are sensors, GSM modem, Atmega 16 microcontroller and actuators. Steps for module two is written below.

1- Receive the control signal or command signal from GSM modem of central System.
2- GSM modem sends this signal to the microcontroller. And microcontroller set this signal data as reference point.
3- Microcontroller Compare reference point data and sensors data.
4- According to difference it switching the actuators until the sensor data match with the reference point data.

4. Simulation Results

In this project there is need of converting analog signal into digital because the sensors used in this system like; LDR, Temperature sensor, Humidity sensor etc. has analog o/p and must be needed to convert in digital form. So I first performed analog to digital conversion than interface temperature sensor, light sensor, Humidity Sensor and GSM communication with computer and GSM communication with controller and controlling actuators according to crop requirement.

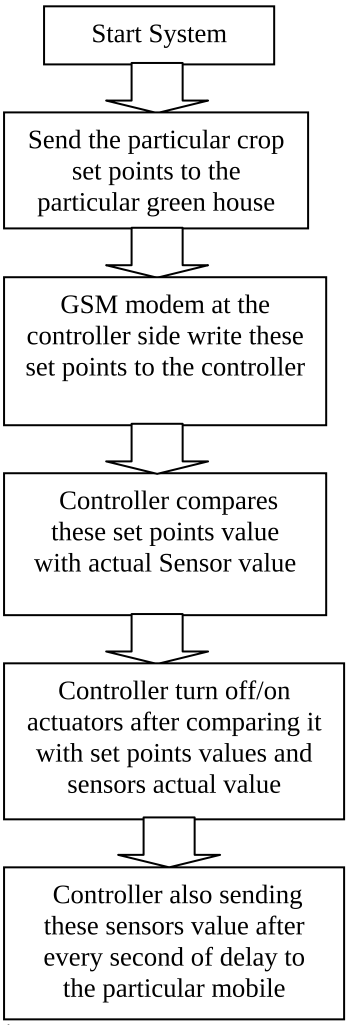


Figure 6: Project Data Flow Diagram

Above diagram shows that first we just have to click on the particular crop and all set points values are send to the particular greenhouse. GSM modem at the controller side writes these set points to the controller. Controller compares these set points value with actual sensor value. Than Controller turn on/off actuators after comparing it with set points values and sensor actual value. Controller also sending these sensors value to the mobile.

5. Conclusion

In this project main aim is to create an intelligent crop management system for multiple greenhouses and this system can also be used for other small medium automation

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