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Automatic Corporate Farming Control Mechanism
(Using Embedded Systems and GSM Technologies)

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Abstract

With increase in population there is a significant decrease in the agricultural land in many countries, especially in a country like India. So there is a necessity to increase the rate of production in agriculture. Corporate farming technique is one of the most advanced farming in the world but its execution involves a large manpower such as collecting different parameters like temperature, soil moisture, humidity etc., we are thereby proposing some ideas concerning the sensors that could effectively collect these parameters and process them using a microcontroller (i.e. embedded systems) and it gives instructions to the controlling units such as heating element, exhaust fan, sprinklers, humidifier, solar shade etc., which correct them to the required level. So here we tend to create a Green House environment with the help of sensors and controlling units. Use of GSM technologies made the communication very easy and reliable. Using such methods will allow farmers to cultivate different crops irrespective of the seasons and location of cultivation.

Keywords

Corporate farming, sensors, controlling units, embedded systems, GSM technology.

INTRODUCTION

This project is designed to create an artificial green house environment for corporate farming. Use of embedded and GSM technologies make this system efficient and reliable. This project makes use of several sensors to collect the data from the present environment and adjusts to comply with the green house conditions. The temperature, humidity, soil moisture sensors senses the temperature, humidity, soil moisture according to the requirement and converts it into an electrical signal, which is applied to the microcontroller through ADC. The microcontroller processes the data that is collected by these sensors and automatically controls the control systems such as sprinkler, humidifier, cooling fan, heating element and solar shade according to the preset threshold values. The microcontroller also displays the status of the individual sensors and the control units through the 16x2 alphanumeric LCD screen. Usage of GSM technology has increased rapidly in past few years because it is very reliable and can be accessed from almost any place on the earth so to know the status of our system we make use of a GSM modem. The GSM modem is interfaced to the microcontroller to send an SMS to the owner/user on request about the status of the sensors and control units.

PROPOSED BLOCK DIAGRAM

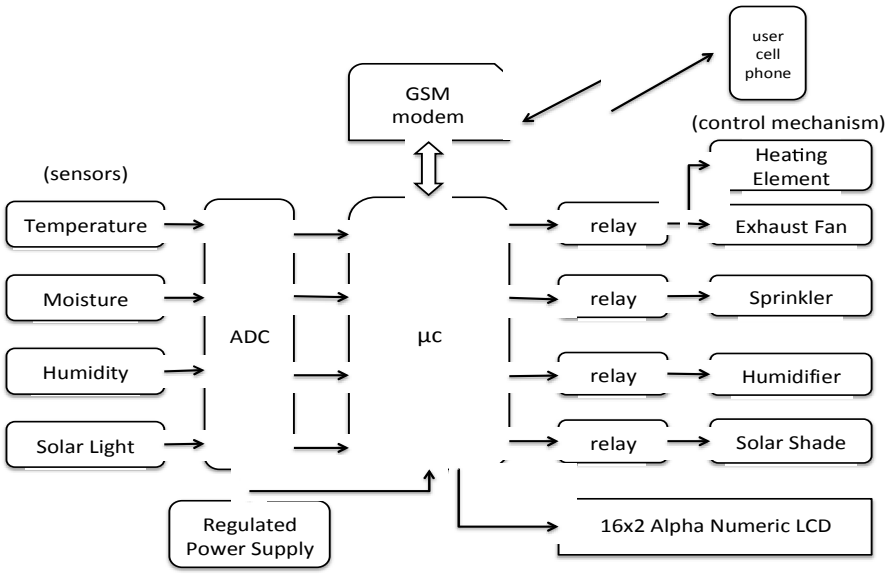

Fig: 2.1 Block diagram showing individual components of the proposed work

SENSOR SELECTION

A. Temperature Sensing Technologies

Temperature sensing technology is one of the most widely used sensing technologies in the modern world. They are often used in many household devices and industries etc. There are different types of temperature sensing technologies such as thermocouples, thermistors, IC's, which have their own advantages and range by which they are used in different applications dependent on their features. Since we are making use of microcontroller its best suited to use an IC temperature sensor, we have many IC temperature sensors like LM20, LM34, LM35, LM94022, LM94023. IC LM35 is widely available in the market and it has many advantages over the other sensors and its range is useful for our purpose. The LM35 does not require any external calibration. The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. LM35 has a range between -55°C to +150°C. Low cost is assured by trimming and calibration at the wafer level.

Features:

- Calibrated Directly in ° Celsius (Centigrade)
- Linear + 10 mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at +25°C)
- Rated for Full −55°C to +150°C Range
- Suitable for Remote Applications
- Low Cost Due to Wafer-Level Trimming
- Operates from 4 to 30 V
- Less than 60-µA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Low Impedance Output, 0.1 Ω for 1 mA Load

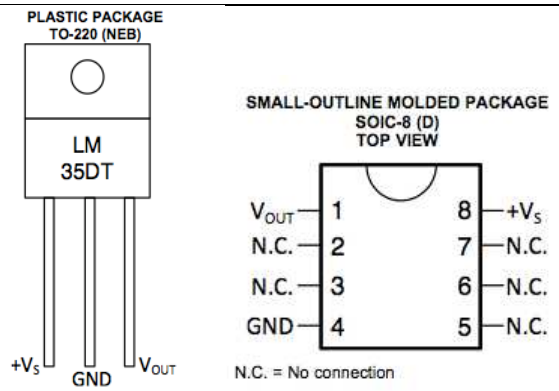

Fig: 3.1 Figures showing two different packages of LM35

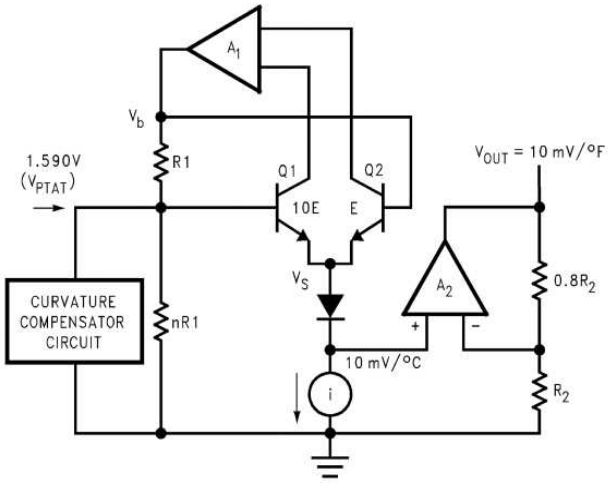

Fig: 3.2 Figure showing the internal schematic of LM35

B. Soil Moisture Sensing Technologies

Soil moisture is one of the major factors, which leads to the good growth of plants, but it is also the worst factor if the levels of soil moisture are higher than the desired level. So monitoring the soil moisture levels in farming is very essential. There are many types of sensors that can measure soil moisture like neutron probes, gypsum blocks, frequency domain reflectometry etc. Neutron probes are very expensive and need approval from the government as they emit radioactive neutrons; gypsum blocks are very cheap which comes with many disadvantages, frequency domain reflectometry sensors are relatively cheap and their overall features are good for use in agriculture equipment, these FDR sensors are generally considered as capacitive in nature, one such a sensor is Soil Moisture Sensors (VG400) in VEGETRONIXTM's family.

Fig3.3 VG400 soil moisture sensor

Features:

- Pre-calibrated
- Insensitive to salinity
- Probe does not corrode over time.
- Consumes less than 600uA.
- Measures volumetric water content (VWC)
- Output Voltage is proportional to moisture level.
- Wide supply voltage range.
- Can be buried and is waterproof.

The sensor measures the dielectric constant of the soil using transmission line. Its input voltage range is between 3.3V to 20V and output ranges between 0 to 3V. Thus, it is very easy and convenient to interface with a microcontroller.

C. Humidity Sensing Technologies

Humidity is also one of the factors that is responsible for the sustained growth of plants excess of which is very harm to plants causing the decay of leaves and sometimes the entire plant, so the necessity of humidity control arise. A humidity sensor measures the humidity content in the atmosphere. Different humidity sensing technologies that are available are thermal conductive, resistive and capacitive humidity sensors. Comparing these technologies thermal conductive humidity sensors have good range but it is very expensive which led us to choose capacitive humidity sensor which have range from 5% to 95% relative humidity.

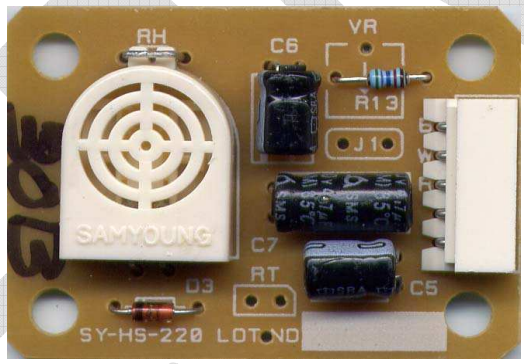

Fig: 3.4 SY-HS-220 humidity sensor.

Capacitive humidity sensor SY-HS-220 humidity sensor have polymer dielectric material between the two conductive plates of the capacitor, the dielectric constant of the material varies between 3 and 15 by which there is a difference in the capacitance value.

Features:

- Operating Humidity: 30 – 90% Relative Humidity
- Voltage Supply: 5.0V DC
- Draws =<3.0 mA of current
- Analog Output: 900 – 3000 mV

D. Light Sensing Technologies

The light source is one of the main factors, which is required by the plants for their sustained growth, they take energy from light for the photosynthesis to happen. There are different types of light sensing technologies such as LDRs, photometric devices, quantum sensors and etc. Quantum sensors and photometric devices have good overall features but they are expensive, LDRs provide good features at low cost. Similar to photometric sensors, LDRs

measure visible light from 400 to 700 nanometers. It has two cadmium sulphide (CdS) photoconductive cells with spectral responses similar to that of human eye. The LDR has to be calibrated in the µc program to a luminance scale.

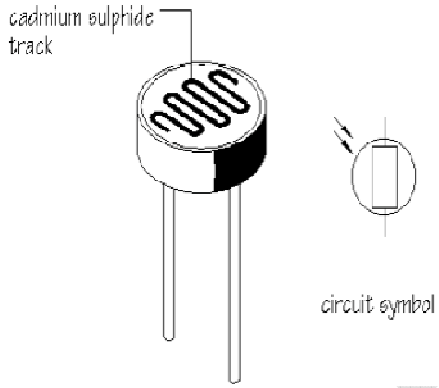

Fig: 3.5 LDR NSL19 M51

II. COMPONENT DESCRIPTION

A. Regulated Power Supply

As all the components in this project operate on +5V DC we need to provide a regulated power supply of +5V DC, this can be achieved by using a step down transformer and a rectifier to convert 220 V 50Hz to 12V DC then with the help of IC7805 we can get a regulated power of +5V DC.

B. LCD Display

We use a 2*16 alphanumeric LCD to display the parameters given by the sensors to the µC. The µC has to be programmed for the display of the characters by the LCD. This LCD is useful to set the threshold values for the control mechanism. Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

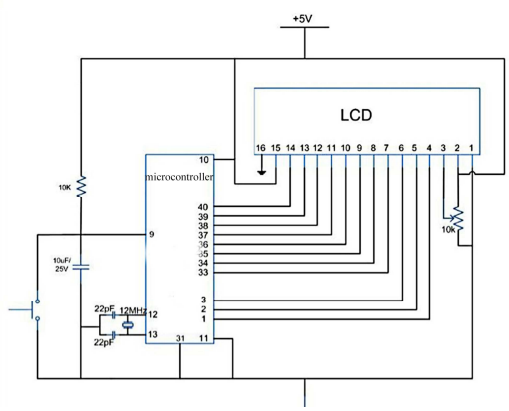

Fig: 4.2 Circuit diagram showing the interface of LCD panel with the microcontroller.

C. Microcontroller and ADC

As we tend to make this automated project use of microcontroller is a must, so we have to select a microcontroller for this project. As all the sensors give analog output, we need to convert these signals into digital before applying to the microcontroller (there is no necessity of an ADC if it is inbuilt in the microcontroller).

D. GSM Modem

GSM technology has grown so much in the mobile industry such that one can get access to a GSM signal at almost every place on the earth. So GSM is very much reliable for controlling things remotely from any place on earth with

the help of our cellphone. So we use a GSM SIM300 modem to communicate with the system. We communicate with our system through a request message for which the controller sends the status of the system to the requested cellphone through the GSM modem.

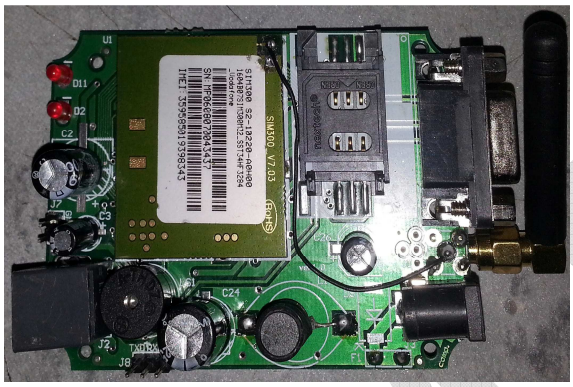

Fig: 4.3 A GSM SIM300 modem

Features:

- Uses the extremely popular SIM300 GSM module
- Provides the industry standard serial RS232 interface.
- Used for GSM based Voice communications, Data/Fax, SMS, GPRS and TCP/IP stack.
- Controlled by standard AT commands.
- Power consumption of 0.25A
- Operating Voltage range: 7–15V

E. Relay

In order to enable a circuit to be isolated from the system only under faulty conditions, protective relays are used. There are different types of relays such as electromagnetic attraction type, electromagnetic induction type, thermal relays, distance relays. Electromagnetic relays are generally used for purposes like this. These relays are electromagnetically operated.

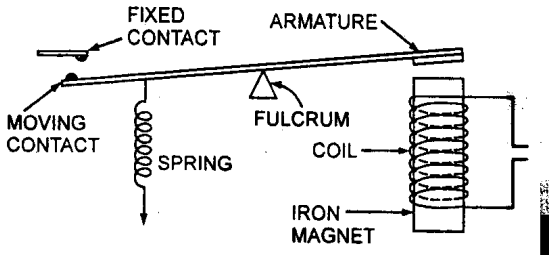

Fig: 4.1 Basic diagrams showing the operating principal of a relay

F. Control Mechanism

To control all the parameters that are required for the sustained growth of plants we need to implement some control mechanism. If the soil moisture is less than the required level a pump is activated to maintain the water content, if temperature or humidity is greater than the optimum level then an exhaust fan is activated, if temperature is less than the required level then the heating device is activated, if humidity is less than optimum level then the humidifier is activated and if solar light intensity is greater than the required level a solar shade equipment covers the region to maintain the optimum light intensity.

III. CONCLUSION

This proposed paper, which is aimed to make use of embedded systems and GSM technology for the advancement in the corporate farming. The sensors and other components that were proposed in this paper are reliable and cost effective. The use of GSM Modem in this project enables the user to get the status of the system from any place.

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