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Environment Monitoring and Device Control Using Arduino Based Embedded Control Sensor Network

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ABSTRACT
This paper mainly deals with integrating the embedded technology in the Agriculture field. It is done by using the Wireless Sensor Nodes (WSN) technology with the help of microcontroller. Wireless Sensor Nodes (WSN) has become very popular technology in the recent past years. This paper describes about the one of the enhancement which can be implemented in WSN system to increase the communication distance between the nodes. In this paper, An ARDUINO based system microcontroller and wireless sensor is used to control the various device and to monitor the information regarding the environment using Zigbee and GSM technology.

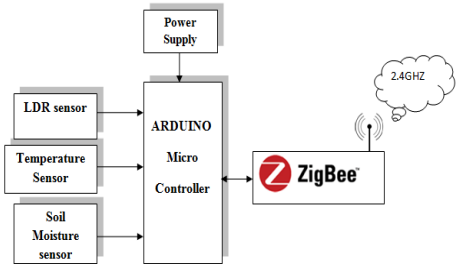
KEYWORDS: ARDUINO Microcontroller; LDR Sensors (Light Dependent Register); Temperature Sensor; Soil Moisture Sensor; Zigbee Module GSM Modem

1 INTRODUCTION
Environment monitoring and device control allows new level of comfort in homes and it can also manage the energy consumption efficiently which in turns promotes the saving. In the twenty first century, there is revolution of the sensor networks which have also come up with various applications like surveillance, traffic control, environmental and wildlife monitoring, agricultural application, home automation and industrial process control. Embedded controlled sensor networks (ECSN) are mainly designed to be application specific so that the energy consumption is minimum as the battery-powered nodes demand life-time of several months or even a few years.

Embedded sensor networks are formed by communicating over wireless links without using a fixed networked infrastructure controlled by microcontroller. Zigbee is the name for a short range, low-power, low-cost, and low-data-rate wireless multi-hop networking technology.

II.BACKGROUND
At present there many system which are used to help the farmers in agriculture field. But all these system has one important drawback that is limited distance. Hence we are going for proposed system where we use GSM technology with Arduino microcontroller.

DESIGN AND IMPLEMENTATION
2.1 Block diagram
Sensor Section:



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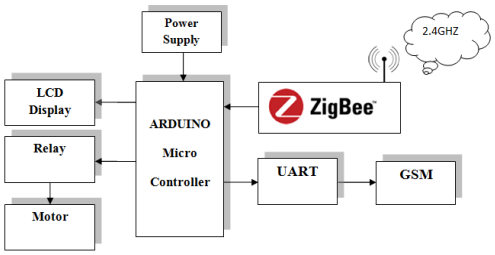
Intermediate Node:

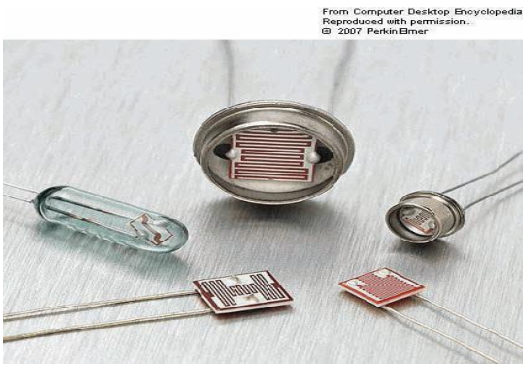


Here we have three sections. In the Sensor section it has LDR, soil moisture and temperature to monitor the agriculture parameters. It has Zigbee module which will transmit the data to the intermediate section. In the intermediate section we have a Zigbee module and a GSM modem. The Zigbee module will receive the data from the Sensor section and analyses it. If the value gets abnormal it will send the message to the farmer's mobile.

Light Dependant Resistor:

Light dependent register sensor will sence the sun light intensity from the environment.

A light dependant resistor also know as a LDR, photo resistor, photoconductor or photocell, is a resistor whose resistance increases or decreases depending on the amount of light intensity. LDRs (Light Dependant Resistors) are a very useful tool in a light/dark circuits. A LDRs can have a variety of resistance and functions. For example it can be used to turn on a light when the LDR is in darkness or to turn off a light when the LDR is in light. It can also work the other way around so when the LDR is in light it turns on the circuit and when it's in darkness the resistance increase and disrupts the circuit.



LDR sensor

How it Works:

The way an LDR works is that they are made of many semi-conductive materials with high resistance. The reason they have a high resistance is that are very few electrons that are free and able to move because they are held in a crystal lattice and are unable to move. When light falls on the semi conductive material it absorbs the light photons and the energy is transferred to the electrons, which allow them to break free from the crystal lattice and conduct electricity and lower the resistance of the LDR.

Soil Moisture Sensor (Order Code S MS-BTA):

Soil Moisture Sensor

The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, and biology. Use the Soil Moisture Sensor to:

- Measure the loss of moisture over time due to evaporation and plant uptake.
- Evaluate optimum soil moisture contents for various species of plants.
- Monitor soil moisture content to control irrigation in greenhouses.
- Enhance your Bottle Biolo

How the Soil Moisture Sensor Works:

The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil.

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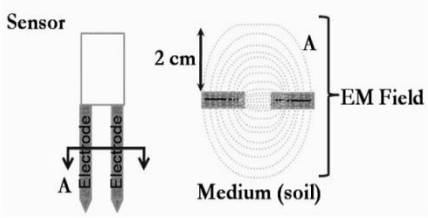
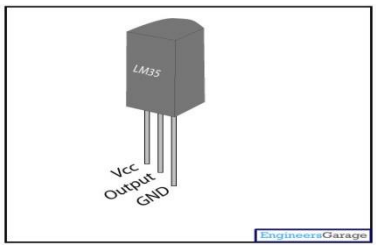


dielectric permitivity of Soil Moisture Sensor

The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The figure above shows the electromagnetic field lines along a cross section of the sensor, illustrating the 2 cm zone of influence.

TEMPERATURE SENSOR



FigTemperature sensor

LM35 is a precision IC **temperature sensor** with its output proportional to the temperature (in ºC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0. 1 ºC temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ºC rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/ ºC.

Pin Description:

Pin No	Function	Name
1	Supply voltage; 5V (+35V to -2V)	Vcc
2	Output voltage (+6V to -1V)	Output
3	Ground (0V)	Ground

Relay

We are using relay to control the motor by help of Arduino microcontroller. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts. Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

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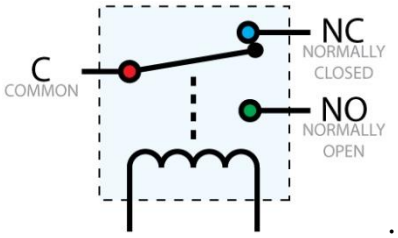


relay switch

relay kit

Relays are used wherever it is necessary to control a high power or high voltage circuit with a low power circuit.The first application of relays was in long telegraph lines, where the weak signal received at an intermediate station could control a contact, regenerating the signal for further transmission. High-voltage or high-current devices can be controlled with small, low voltage wiring and pilots switches.

ZigBee Module

In this paper we are using two zigbee module LM35,One zigbee will placed in sensor section (paddy fild) which will transmit the data and the another zigbee module will placed in intermediate node (monitoring room) which will receive the data from the sensor section and transmit the data to GSM module.

zig bee module RS232

ZigBee Module is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Temco has developed a embedded antenna of wireless data communication module, which adopts standard ZigBee wireless technology. This module is in line with the Industry Standard applications of wireless data communication module.

ARDUINO MICROCONTROLER

Here we are using ARDUINO microcontroller advantage of arduino in compare to other microcontroller it is an open source prototype platform based on easy to use hardware and software.

The ARDUINO Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the ARDUINO Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

Schematic and Design

Arduino Nano 3.0 (ATmega328): schematic, Eagle files.

Arduino Nano 2.3 (ATmega168): manual (pdf), Eagle files. Note: since the free version of Eagle does not handle more than 2 layers, and this version of the Nano is 4 layers, it is published here unrouted, so users can open and use it in the free version of Eagle.

ARDUINO microtroller

Specifications:

Microcontroller Atmel ATmega168 or ATmega328

Operating Voltage (logic level) 5 V

Input Voltage (recommended) 7-12 V

Input Voltage (limits) 6-20 V

Digital I/O Pins 14 (of which 6 provide PWM output)

Analog Input Pins 8

DC Current per I/O Pin 40 mA

Flash Memory 16 KB (ATmega168) or 32 KB (ATmega328) of which 2 KB used by bootloader

SRAM 1 KB (ATmega168) or 2 KB (ATmega328)

EEPROM 512 bytes (ATmega168) or 1 KB (ATmega328)

Clock Speed 16 MHz

Dimensions 0.73" x 1.70"

Length 45 mm

Width 18 mm

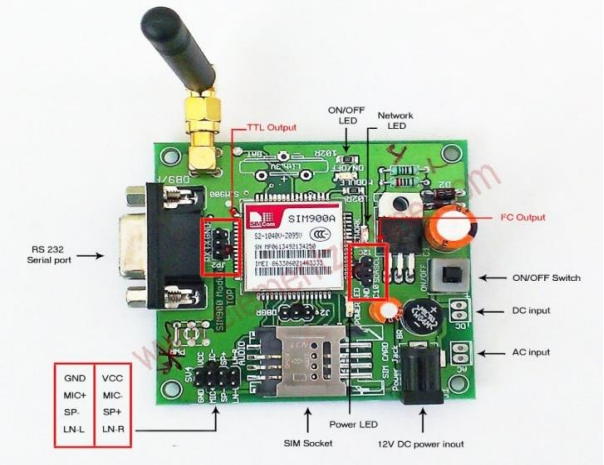
Weigth 5 g

Power:

The ARDUINO Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

GSM Module

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).



GSM module kit

Here we are using GSM module to communicate with farmer's authorized mobile number.

Transformer:

The function of the transformer is to step down the available ac source of 230 volts. The transformer selected is a 0-12v transformer. The current rating of the transformer is 1 A on the low voltage side. Since we require +5V DC sources with a common ground. The 230 AC voltages are stepped down using this step down transformer. At the secondary the 230v AC it is reduced to 12V RMS outputs measured with respect to ground.

Rectifier Unit:

Using a full wave bridge rectifier then rectifies the reduced AC source of 12 volts RMS and it is converted into pulsating DC available in three outputs. The three outputs are the positive, negative and the ground. This DC is pulsating and it needs filtering. This unregulated DC is applied to the 7805 IC voltage regulator and at the output we can obtain +5V regulated output.

Filter Capacitors:

The positive and the negative DC outputs have ripple in them and they are called pulsating DC. The ripple

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coming along the DC has to be removed. The ripple being the combined effect of the high frequency components has to be removed and this is done by the two capacitors. These two capacitors are essential for the positive and the negative bus. The capacitors selected are of the electrolytic type and are rated 25 volts 2200 MFD.

Once the filtering is done the bus bar voltage is steady DC and is now not pulsating and it is free from ripples. However the capacitor gets charged to the peak value and therefore the voltage across the capacitor will be 9 * 1.414 volts. From this filtered pure DC source we have to get the operating 7805-voltage regulator IC.

Voltage Regulator Units:

The function of the voltage regulator units are that when the output of the filters provide DC of a higher value than that is required the output of the regulator r is constant of say + 5 volts. In spite of the variations in the supply voltage the output remains constant at the stipulated level.

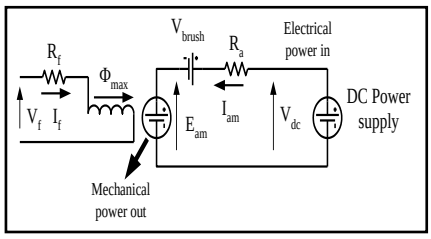
DC MOTORS

DC motor is used to drive a mechanical load. In this lab, a separately excited DC generator provides the load. The load on the motor is adjusted by varying the generator field current. By increasing the field current of the DC generator, the load on the DC motor increases and thus the armature current increases. In general, DC motors are characterized by their torque-speed curves as shown in Figure Since the measuring equipment for shaft torque is not available in the lab it is necessary to use alternative means of characterizing the DC motor.

DC Motor Equivalent circuit

The following figures show the equivalent circuit of a separately excited dc motor. Equivalent circuit is similar to the generator only the current directions are different. The operation equations are:
Armature voltage equation

$$V_{dc} = E_{am} + I_{am} R_a + V_{brush}$$



DC motor Equivalent circuit

Turning a motor ON and OFF requires only one switch to control a single motor in a single direction. What if you want your motor to reverse its direction? The simple answer is to reverse its polarity. This can be achieved by using four switches that are arranged in an intelligent manner such that the circuit not only drives the motor, but also controls its direction. Out of many, one of the most common and clever design is a H-bridge circuit where transistors are arranged in a shape that resembles the English alphabet "H". As you can see in the image, the circuit has four switches A, B, C and D. Turning these switches ON and OFF can drive a motor in different ways.

1. Turning on Switches **A** and **D** makes the motor rotate clockwise
2. Turning on Switches **B** and **C** makes the motor rotate anti-clockwise
3. Turning on Switches **A** and **B** will stop the motor (Brakes)
4. Turning off all the switches gives the motor a free wheel drive
5. Lastly turning on **A** & **C** at the same time or **B** & **D** at the same time shorts your entire circuit. So, do not attempt this.

RESULT

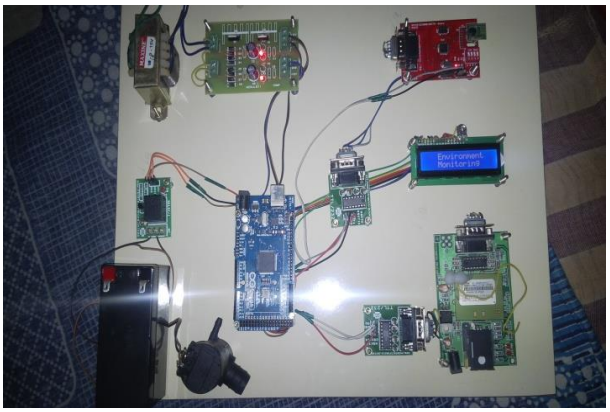
The farmer will gate three types of message by the GSM technology.

1. If the soil will wet, than it will be sence and send the message to the farmer's mobile, that the soil is wet.
2. If the soil will dry than it will be sence and motor will get switched

on automatically by using relay and the message will send to the farmer's mobile, that, soil is dry and motor has switched on.

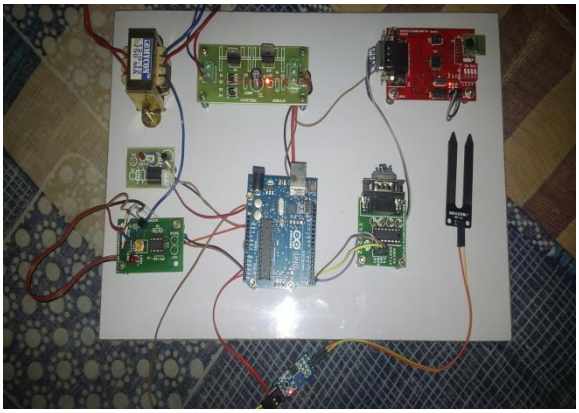
3. In three conditions, If the temperature is high, sun light intensity is high and soil is dry than it will be sence and message will send to the farmers's mobile, that the sky is clear.

FINAL DESIGN



Intermidiate node

This kit is mainly used for monitoring room purpose



Sensors section

This kit is mainly used for field purpose

CONCLUSION

This paper demonstrates designing of embedded controlled sensor networks used for controlling the home devices as well as monitoring the environmental parameters. The features of GSM and Zigbee are explored to design the system for long distance as well as short distance. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for indoor environmental monitoring systems. Three commercial sensors had been integrated with the system to monitor and compute the level of existence of CO gas, temperature and humidity in atmosphere using information and communication technologies.

Future Scope

The future of this project is to save the time and effort of farmer's, who works continuously day and night in all season

By the help of this project they can save fual expenses.

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