GSM BASED AGRICULTURE MONITORING SYSTEM

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Abstract - *Last 10 years have seen a rapid evolution in this technology. In the United States, ongoing research in precision agriculture has been effectively applied to large agri-businesses at scale. But small farmers do not have the capital resources to invest in expensive monitoring systems. Hence to address these issues, we have designed an Arduino based agriculture monitoring system which operates on GSM network. This system will monitor the humidity levels and surrounding temperature and control the water flow accordingly. The controller activates the relay driver unit when the message is received through GSM and pumps motor by using relay switches. This design can be used for alarming the user via SMS (Short message service) if the moisture level and temperature goes beyond threshold value.*

***Key Words*: GSM, agriculture, soil moisture sensor, temperature sensor, monitoring, Arduino**

1. INTRODUCTION

Agriculture plays an important role in economy and development. The agriculture is in the transition from traditional agriculture to modern agriculture currently. For continuously increasing demand of food necessities, rapid improvement in production of food technology is important. In the paper our main focus is to maintain, control or monitor the agricultural trends or system making it easier for the user, to get data at regular interval about the field. In many areas one person is not enough to monitoring the field status and control things. To improve we have to focus on the agriculture monitoring system and to collect more area information. In agriculture, there are two important factors, first to get information about fertility of soil and second is to measure moisture content in soil. Nowadays for irrigation, different techniques are available which is used to reduce the dependency on rain. And mostly this technique is driven by electrical power and on/off scheduling controlled system. Here we have used sensors to create an agricultural monitoring system like soil moisture sensor, temperature sensor. Soil moisture sensor is basically used to measure the soil moisture level and the temperature sensor is used to keep the track of temperature.GSM sim 900 is being used for sending the data to the user.

1.1 SYSTEM ARCHITECTURE

Fig shows the block diagram of smart agriculture monitoring system.GSM module is used to keep information about the changes in the climate.

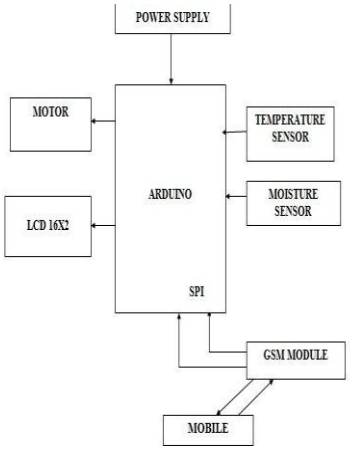

fig.1

A. Hardware used

a) ATmega328

b) GSM SIM 900 module

c) LM35 temperature sensor

d) Soil moisture Sensor

e) LCD module

f) Relay board

g) Motor

ATmega328:

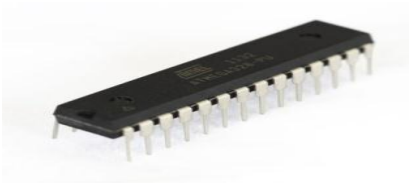

fig.2

ATMega328 is the ATMEL Microcontroller on which Arduino UNO is based. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz Serial data to the MCU is clocked on the rising edge and data from the MCU is clocked on the falling edge. Power is applied to VCC while RESET and SCK are set to zero. ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed.

GSM SIM 900:

fig.3

The words, "Mobile Station" (MS) or "Mobile Equipment" (ME) are used for mobile terminals Supporting GSM services. A call from a GSM mobile station to the PSTN is called a "mobile originated call" (MOC) or "Outgoing call", and a call from a fixed network to a GSM mobile station is called a "Mobile Terminated call" (MTC) or "incoming call".AT commands are instructions used to control a modem.AT is the abbreviation of ATtention. Every command line starts with "AT" or "at".

LM35:

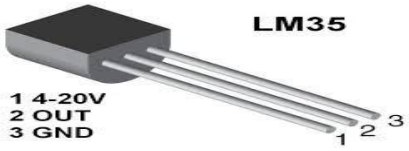

fig.4

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). 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 °C 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 °C rise/fall in ambient temperature, *i.e.,* its scale factor is 0.01V/ °C.

SOIL MOISTURE SENSOR:

fig.5

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. Technologies commonly used in soil moisture sensors include:

- Neutron moisture gauges, utilize the moderator properties of water for neutrons.

- Electrical resistance of the soil

In this particular project, we will use the moisture sensors which can be inserted in the soil, in order to measure the moisture content of the soil.

LCD MODULE:

A 16X2 LCD is connected with Arduino at 2, 3, 4,5,11 and 12 pins to display the reading of various sensors.

RELAY:

Relays are simple switches which can be operated both mechanically and electrically in which electromagnet is present. Relay works when there is a low-power signal and

this information is used to control the circuit. It is used, where a number of circuits are controlled by a single signal. They are used for switching incoming signals from one source to different destinations. Relays are also used to perform Boolean and other logical operations in a computer.

B. Software Description

Arduino is a single-board microcontroller designed to make the process of using electronics in multidisciplinary projects more accessible. The hardware consists of a simple open-source hardware board designed around an 8-bit Atmel AVR microcontroller, though a new model has been designed around a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller.

The Arduino board is made up of an Atmel AVR microprocessor, a crystal or oscillator (a crude clock that sends time pulses at a specified frequency to enable it to operate at the correct speed) and a 5V voltage regulator.

To program the Arduino the Arduino IDE is used which is free software that enables programming in the language that the Arduino understands. In the case of the Arduino, the language is based on C/C++ and can even be extended through C++ libraries. The IDE enables writing a computer program, which is a set of step-by-step instructions that is then uploaded to the Arduino. Arduino will then carry out those instructions and interact with whatever it has been connected to it. In the Arduino world, programs are known as "sketches".

ARDUINO UNO:-

Table. 1

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 Ma
DC Current for 3.3V Pin	50 Ma
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. The power pins are: Vin, 5V, 3V3, GND, IOREF.

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

fig.6

1.2 WORKING

Arduino board is connected to GSM modem in which transmitter of Arduino is connected to the receiver of GSM modem and receiver of Arduino is connected to the transmitter of GSM modem. GSM modem is working simply like a mobile phone when we message on the number of GSM modem it replies back and can be operated according to the coding which we have done in microcontroller. The soil moisture sensor and temperature sensor are connected to analog pins of an Arduino board. 5v power supply is generated from USB cable which is connected to Arduino board. First of all GSM/GPRS module is initialized and waits until it connects to the network.12v power supply is scheduled to the GSM/GPRS module through adaptor. The red light indicator illustrates GSM/GPRS is ON. The data sensed by soil moisture sensor and temperature sensor is transmitted to micro-controller. Threshold values are programmed into an Arduino board initially. So, the values which are received from sensors are compared with threshold values. If the readings from the temperature sensor are more than the threshold value and the soil moisture reading is lesser than the threshold value. Then a SMS alert is sent to the user by GSM/GPRS module. Then the motor pump is switched ON by the user as soon as the message ON is received.

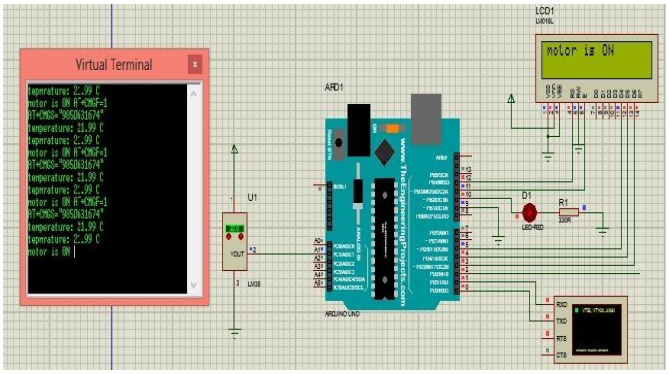

fig.7 (Simulation Result)

2. FUTURE SCOPE

This project has enormous potential and may be used in various other ways, due to its cheap and cost efficient design. For further easy access the data can also be displayed on android applications. The iteration of this project is for data monitoring. The future iteration will include data collection at base station and incorporation of additional remote stations to directly control irrigation systems. Web services for alerting and analytics will be added, in addition to a monitoring user interface. We can also use web camera to capture live crop images over Wi-Fi.

3. CONCLUSIONS

The progress in electronics and telecommunication engineering, paved way for new inventions and technologies. As we are moving towards miniaturization, handy components are needed which has better accuracy and reliability. Here we are developing an embedded system which will help in agricultural field to monitoring field.

The sensors present in the system measure various parameters. The sensed data is transmitted to the receiver station via SMS by GSM module. The decisions that are taken by the motor depend on the sensors response i.e. from soil moisture sensor and humidity sensor as well as the message received. Simulation is performed by using Proteus software by placing appropriate sensors like temperature and soil moisture sensor and the results are analyzed under different conditions.

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