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Implementation of Automatic Fertigation System by Measuring the Plant Parameters

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***Abstract*— This paper describes that the measurement of different parameters at the horticulture. The system will monitor the basic parameters in horticulture field such as pH level, temperature, soil moisture, water flow and the characteristics of the soil. It also includes the automatic feeding of fertilizers based on the measurement of essential nutrients in the soil in order to yield effective growth.**

***Keywords*— pH Sensor, Fertigation, MSP 430.**

I. INTRODUCTION

Instrumentation is a field in which the system or the device can respond with respect to environmental condition change. Most of the industries familiar with sensors like temperature, humidity, pH, level, moisture, flow, leak detector etc.

Agriculture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. For instance, in one system plant water status was monitored and irrigation scheduled based on canopy temperature distribution of the plant, which was acquired with thermal imaging. In addition, other systems have been developed to schedule irrigation of crops and optimize water use by means of a crop water stress index (CWSI). The empirical CWSI was first defined over 30 years ago. This index was later calculated using measurements of infrared canopy temperatures, ambient air temperatures, and atmospheric vapor pressure deficit values to determine when to irrigate broccoli using drip irrigation.

II. FERTIGATION

Fertigation is the application of fertilizers, soil amendments, or other water-soluble products through an irrigation system. Fertigation is used extensively in commercial agriculture and horticulture and is starting to be used in general landscape applications as dispenser units become more reliable and easy to use.

Irrigation systems can also be automated through information on volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, instead of a predetermined irrigation schedule at a particular time of the day and with a specific duration. An irrigation controller is used to open a solenoid valve and apply watering to horticultural plants when the volumetric water content of the substrate drops below a set point.

Figure 1 Fertigation using poly bag

Chemigation, a related and sometimes interchangeable term, is the application of chemicals through an irrigation system. Chemigation is considered to be a more restrictive and controlled process, due to the potential nature of the products being delivered-pesticides, herbicides, fungicides - to cause harm to humans, animals, and the environment.

III. CREATION OF GENERALIZED BLOCK

Building the block diagram for an idea is necessary part in order to examine the overall operations of the defined solutions. In this it describes pH, temperature, level, and humidity, soil moisture as an input and feed tank valve control, water tank valve, motor relay, and display unit as an output. The following figure 2 shows the block of the project.

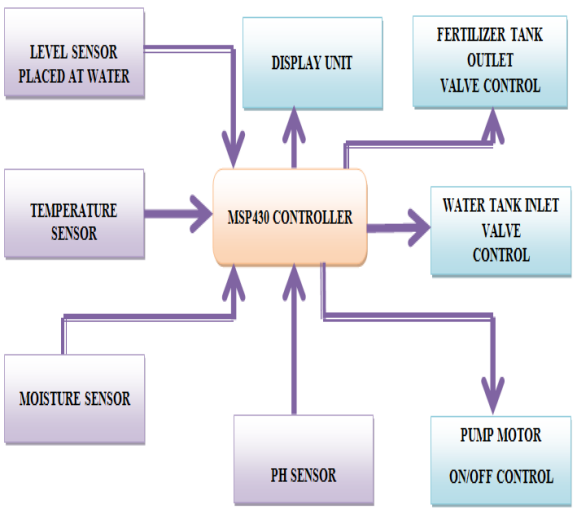

Figure 2: General block diagram

IV. PROPOSAL OF THE PAPER

Modern agriculture faces many challenges, such as climate change, environmental pollution, water shortages and the increased societal demand of food production. Precision agriculture is the promising solution, which is based on observing and responding to intra- field variations. According to this thought, based on the investigation of Chinese agricultural information web network community and analysis of China's agricultural information service guided by mobile Interconnection concept thus to make Chinese agricultural information cyber source system as a sustainable development center dynamic information sources, guiding agricultural information users have a "pure" point to surface communication in a broader space and ensuring agricultural network community users to have more specialized and simplified "self-organization" information using space.
Hence this project will give an outline to automate all those things as mentioned above. It will be done by help of microcontroller. Float level and pH sensors be placed in the tank and field respectively and then it is interfaced with control unit. There also provisional for fertilizer feeding by monitoring the different parameters then automating the equipment by measuring them at the particular band value. There also provisional to monitor the level of water at tank. If it gets empty, the motor will off automatically. Hence it reduces the manual work.

V. MSP430F24X

The Texas InstrumentsMSP430 family of ultra-low power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low-power modes, is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The calibrated digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 1 µs.

The MSP430F23x/24x (1)/2410 series are microcontroller configurations with two built-in 16-bit timers, a fast 12-bit A/D converter (not MSP430F24x1), a comparator, four (two in MSP430F23x) universal serial communication interface (USCI) modules, and up to 48 I/O pins. The MSP430F24x1 devices are identical to the MSP430F24x devices, with the exception that the ADC12 module is not implemented. The MSP430F23x devices are identical to theMSP430F24x devices, with the exception that a reduced Timer B, one USCI module, and less RAM is integrated.

i). Features

- Low Supply-Voltage Range, 1.8 V to 3.6 V
- Ultra-Low Power Consumption:
  - Active Mode: 270 µA at 1 MHz, 2.2 V
  - Standby Mode (VLO): 0.3 µA
  - Off Mode (RAM Retention): 0.1 µA Ultra-Fast Wake-Up From Standby Mode in Less Than 1 µs
- 16-Bit RISC Architecture, 62.5-ns Instruction Cycle Time
- 12-Bit Analog-to-Digital (A/D) Converter With Internal Reference, Sample-and-Hold, and Auto scan Feature
- 16-Bit Timer A With Three Capture/Compare Registers
- 16-Bit Timer B With Seven Capture/Compare-With-Shadow Registers
- MSP430F247, F2471 - 32KB+256B Flash Memory, 4KB RAM
- Available in 64-Pin QFP and 64-Pin QFN Packages

VI. TEMPERATURE SENSOR

Temperature sensors are devices used to measure the temperature of a medium. It played a significant role in everyday products. For example, household ovens, refrigerators, and thermostats all rely on temperature maintenance and control in order to function properly.
From a thermodynamics view, temperature changes as a function of the average energy of molecular movement. As heat is added to a system, molecular motion increases and the system experiences an increase in temperature. It is difficult, however, to directly measure the energy of molecular movement, so temperature sensors are generally designed to measure a property which changes in response to temperature. The devices are then calibrated to traditional temperature scales using a standard

VII. LEVEL SENSOR

Measurement of fluid level is done by help of level sensor. Free flowing substances can be measured by using this sensor, such as water, oil, slurries, fuel etc. Granular/powder form solids (solids which can flow) also can be measured. It is classified in different ways depends on kinds. The following figure shows the classification of sensor.

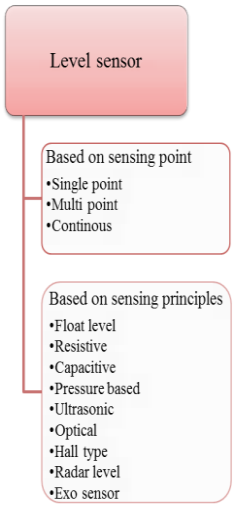

Figure 3: Level sensor types

VIII. PH SENSOR

A pH sensor is an electronic device used for measuring the pH (acidity or alkalinity) of a liquid (though special probes are sometimes used to measure the pH of semi-solid substances). A typical pH meter consists of a special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the pH reading.
The pH of a solution indicates how acidic or basic (alkaline) it is. The pH term translates the values of the hydrogen ion concentration which ordinarily ranges between about 1 and 10x-14gram-equivalents per liter - into numbers between 0 and 14. On the pH scale a very acidic solution has a low pH value such as 0, 1, or 2 (which corresponds to a large concentration of hydrogen ions;
10 x 0, 10 x -1, or 10 x -2 gram-equivalents per liter) while a very basic solution has a high pH value, such as 12, 13, or 14 which corresponds to a small number of hydrogen ions. A neutral solution such as water has a pH of approximately 7.

Figure 4: pH Sensor

IX. HUMIDITY SENSOR

Humidity is the measure of water vapor present in a gas. Vapor is a term that refers to the gaseous form of a substance that normally exists as a solid or liquid. When liquid exists as a gas, it exerts pressure on its surroundings. This pressure determines the amount of vapor in the air at a given temperature.

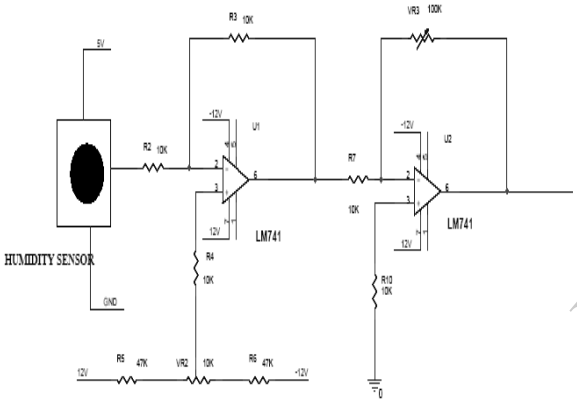

Figure 5: Schematic (Humidity)

The humidity sensor is consists of astable muliti vibrator in which the capacitance is varied depends on the humidity level. So the multi vibrator produces the varying pulse signal which is converted into corresponding voltage signal. The voltage signal is given to inverting input terminal of the comparator. The reference voltage is given to non-inverting input terminal. The comparator is designed by the LM 741 operational amplifier. The comparator is compared with reference humidity level and delivered the corresponding error voltage at its output which is given to next stage of gain amplifier in which the variable resistor is connected in the feedback path by adjusting the resistor we can get the desired gain. Then the final voltage is given to microcontroller or other circuit in order to find the humidity level in the atmosphere.

X. RESULTS AND DISCUSSION

Initially the MSP430 247 is configured through parallel port with help of work bench. Level sensor is tested for different voltage level with help of voltage divider bias circuit. It is then interfaced to the controller at the channel 6 (PORT 6).

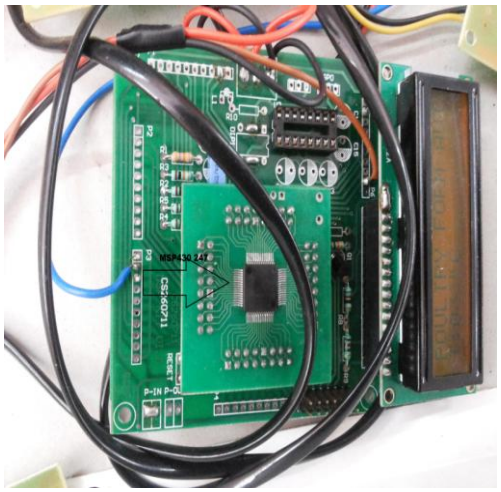

Figure 6: MSP430

Basically the level sensor will produce 4 to 20mA current output. In practical without level transmitter the sensor won't give the output. So it is necessary to interface sensor to controller through transmitter. Here magneto type used for level measurement due to cost constraints.

Figure 7: pH Sensor

The level of the tank is maintained in particular level. If the level is exceeds or below the prescribed level then the micro controller will turn on/off the motor function. First if the level is below 125, then the motor (power saving purpose) which is activated by relay will be turned off. Suppose if the tank is over filled then there is possibility of water overflow. Hence in order to avoid it there is also provision for water out. If level is above 255, then the motor which is activated by relay will be turned on.

Figure 8: Motor off mode

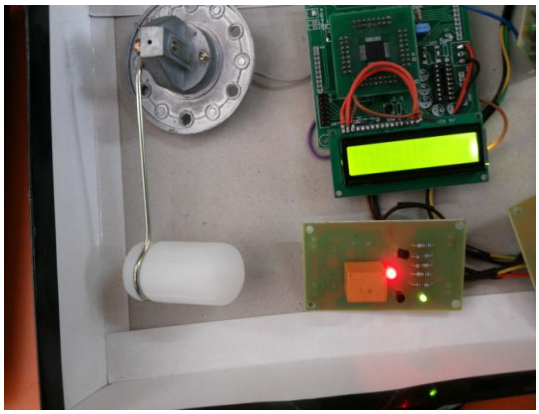

Figure 9: Motor on mode

XI. CONCLUSION

Water resources are becoming scares in many Asian countries including India for the last several years. The importance of optimized and efficient irrigation management system development has become the need of time especially the irrigation system that takes decisions over crops soil water contents and environmental parameters. The system design for horticulture farm automation has been analyzed at different levels. The sensors have been interfaced in order to automate the fertigation system. In this paper, fertigation management system for container grown crops is presented. It is deployed inside nursery of our institute for efficient utilization of water. MSP430 boards are used to sense temperature, air humidity and soil moisture after a defined interval of time and sent it to a central location via gateway. Embedded coding is done for the first level process in C language and simulated by using IAR work bench. Executable file is diffused into the controller with help of parallel port terminal.

XII. REFERENCES

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