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# Design and Development of Precision Agriculture Systems Using Wireless Sensor Network

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***Abstract*** *- Crop farming in India is labour intensive and obsolete. Farming is still dependent on techniques which were evolved hundreds of years ago and doesn't take care of conservation of resources. The newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. We have the technology to bridge the gap between water usage and water wastage. Technology used in some developed countries is too expensive and complicated for a common farmer to understand. Our project is to give cheap, reliable, cost efficient and easy to use technology which would help in conservation of resources such as water and also in automatizing farms. We proposed use of temperature and moisture sensor at suitable locations for monitoring of crops. The sensing system is based on a feedback control mechanism with a centralized control unit which regulates the flow of water on to the field in the real time based on the instantaneous temperature and moisture values. The sensor data would be collected in a central processing unit which would take further action. Thus by providing right amount of water we would increase the efficiency of the farm. The farmer can also look at the sensory data and decide course of action himself. We have made the interface of our project keeping in view the educational and financial background of average Indian farmer. In this paper we are proposed a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various locations of farm and as per the need of crop controller take the decision to make irrigation ON or OFF.*

***Keywords: Soil moisture sensor, temperature sensor, wireless sensor network, Microcontroller***

## 1. INTRODUCTION

Precision agriculture is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. Precision agriculture can be defined as the art and science of using advanced technology to enhance crop production. Sensor network and embedded systems are the major technologies that drive the development of precision agriculture. Climate change, population growth and increasingly scarce resources are putting agriculture under pressure. Farmers must harvest as much as possible from the smallest possible land surface. In last decades there have been tremendous advancements in technology for agriculture and growth of final yield. Due to uneven natural distribution of rain water it is very crucial for farmers to

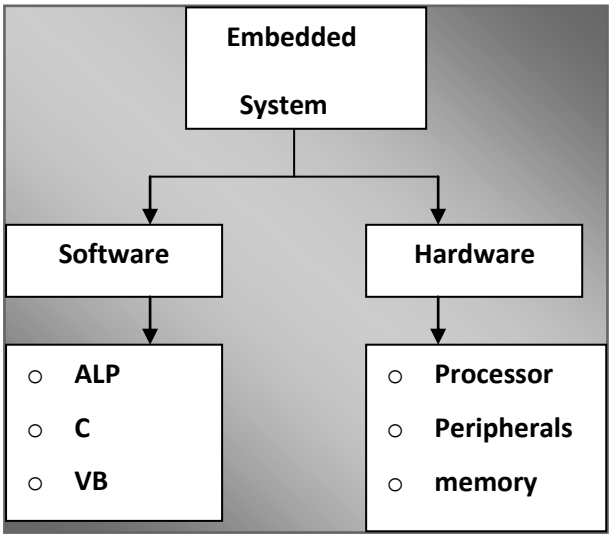
monitor and control the equal distribution of water to all crops in the whole farm or as per the requirement of the crop. The agricultural scenario seems to be one of the most promising application areas due to the necessity of providing the agricultural production chain in terms of precision and quality. This involves a careful system design, since requirements are very strict, battery life-time maximization, robustness, recovery strategies, network flexibility and re-configurability boosting competitiveness through more efficient practices. Embedded systems plays an important role.

The very simplest embedded systems are capable of performing only a single function or set of functions to meet a single predetermined purpose. In more complex systems an application program that enables the embedded system to be used for a particular purpose in a specific application determines the functioning of the embedded system. The ability to have programs means that the same embedded

system can be used for a variety of different purposes. In some cases a microprocessor may be designed in such a way that application software for a particular purpose can be added to the basic software in a second process, after which it is not possible to make further changes. The applications software on such processors is sometimes referred to as firmware.

As the embedded system is the combination of both software and hardware. Software deals with the languages like ALP, C, and VB etc., and Hardware deals with Processors, Peripherals, and Memory.

Memory: It is used to store data or address.
Peripherals: These are the external devices connected.
Processor: It is an IC which is used to perform some task.




## 2. LITEATURE SURVEY

Irrigation is one of the fundamental problems of agriculture in developing countries. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains and scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency.

Crop farming in India is labour intensive and obsolete. Farming is still dependent on techniques which were evolved hundreds of years ago and doesn't take care of conservation of resources. The newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. We have the technology to bridge the gap between water usage and water wastage. Technology used in some developed countries is too expensive and complicated for a common farmer to understand.

The moisture sensors used had a much effect due to fertilizers used. Further works are going on to increase the efficiency of the moisture sensors so as to minimize the effects of fertilizers on the value of soil moisture. and allows the programmer to learn a small but flexible set of instructions. and allows the programmer to learn a small but flexible set of instructions. The system helps for increasing irrigation efficiency by reducing the labour cost and saving water and electricity. The major hurdle in

adopting the drip irrigation system in large scale is its initial cost is very high which is not affordable to Indian farmer.

## 3. PROPOSED MODEL

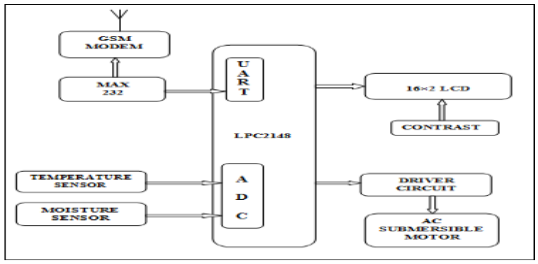
The precision agriculture embedded systems deals with Real time atomization of agricultural environment for social modernization of Indian agricultural system using ARM7 and GSM is focused on auto mazing the irrigation system for social welfare of Indian agricultural system. The project is implemented by using advanced processor ARM7TDMI which is a 32 bit microprocessor, GSM serves as an important part as it is responsible for controlling the irrigation on field and sends them to the receiver through coded signals. GSM operates through SMSs and is the link between ARM processor and centralized unit.

ARM7TDMI is an advanced version of microprocessors and forms the heart of the system. Our project aims to implement the basic application of atomizing the irrigation field by programming the components and building the necessary hardware.

This project is used to find the exact field condition. GSM is used to inform the user about the exact field condition. The information is given on user request in form of SMS. GSM modem can be controlled by standard set of AT (Attention) commands. These commands can be used to control majority of the functions of GSM modem.

**Block Diagram:**

In this project we are using LPC2148, Temperature sensor, Dry/wet sensor to detect the soil moisture condition automatically and 16X2 LCD is used to display their values with the help of in built Analog to digital converter and the people can access the information of sensors with the help of simple SMSs by using GSM technology. An ac motor is also connected to get the water when ever dry condition is detected. GSM is used to inform the user about the exact field condition. The information is given on user request in form of SMS. GSM modem can be controlled by standard set of AT (Attention) commands. These commands can be used to control majority of the functions of GSM modem. This project uses two power supplies, one is regulated 5V for modules and other one is 3.3V for LPC2148. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac out put of secondary of 230/12V step down transformer. An ac motor is also connected to get the water when ever dry condition is detected.




The LPC2148 are based on a 16/32 bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT,PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. With a wide range of serial communications interfaces, they are also

very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

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## 4. HARDWARE IMPLEMENTATION

A **sensor** is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.

The development of precision agriculture embedded system mainly depending on two main sensors

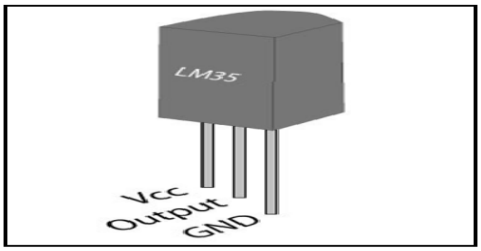
- LM35 (TEMPERATURE SENSOR)
- SOIL MOISTURE SENSORS

The other hardware requirements are

- LPC 2148
- GSM
- LCD
- Max 232
- Power supply

### LM35 Precision Centigrade Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus 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 convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.




**Moisture Sensor (Dry and Wet sensor):**

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons. Cheaper sensors -often for home use- are based on two electrodes measuring the resistance of the soil. Sometimes this simply consists of two bare

(galvanized) wires, but there are also probes with wires embedded in gypsum.

**LPC2148 Controller:**

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kb to 512 kb. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kb up to 40 kb, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

**MAX 232 :** The **MAX232** is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits competitiveness through more efficient practices. outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), competitiveness through more efficient practices. outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

## 5. SOFTWARE IMPLEMENTATION

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

**Steps to write an assembly language program in keil and how to compile it:**

1. Install the Keil Software in the PC in any of the drives.
2. After installation, an icon will be created with the name “Keil uVision3”. Just drag this icon onto the desktop so that it becomes easy whenever you try to write programs in keil.
3. Double click on this icon to start the keil compiler.
4. A page opens with different options in it showing the project workspace at the leftmost corner side, output window in the bottom and an ash coloured space for the program to be written.
5. Now to start using the keil, click on the option “project”.

6. A small window opens showing the options like new project, import project, open project etc. Click on "New project".
7. A small window with the title bar "Create new project" opens. The window asks the user to give the project name with which it should be created and the destination location. The project can be created in any of the drives available. You can create a new folder and then a new file or can create directly a new file.
8. After the file is saved in the given destination location, a window opens where a list of vendors will be displayed and you have to select the device for the target you have created.
9. The most widely used vendor is Atmel. So click on Atmel and now the family of microcontrollers manufactured by Atmel opens. You can select any one of the microcontrollers according to the requirement.
10. When you click on any one of the microcontrollers, the features of that particular microcontroller will be displayed on the right side of the page. The most appropriate microcontroller with which most of the projects can be implemented is the AT89C51. Click on this microcontroller and have a look at its features. Now click on "OK" to select this microcontroller.

**Proload:**

Pro load is a software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller placed in the programmer kit and this is done by the Pro load. Programmer kit contains a microcontroller on it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the keil compiler and dumps this hex file into the microcontroller which is to be programmed. As this programmer kit requires power supply to be operated, this power supply is given from the power supply circuit designed above. It should be noted that this programmer kit contains a power supply section in the board itself but in order to switch on that power supply, a source is required. Thus this is accomplished from the power supply board with an output of 12volts or from an adapter connected to 230 V AC.

## 6. ADVANTAGES &APPLICATIONS

**ADVANTAGES:**

1. Ease of maintenance
2. Accessing the data from any remote place.
3. Less power consumption
4. Very faster communication

**APPLICATIONS:**

1. Industrial Automation
2. Weather stations
3. Home Automation
4. Notice boards

## 7. CONCLUSION

Precision agriculture and embedded systems combine an exciting new area of research that will greatly improve quality in agricultural production, precision irrigation and will have dramatic reduction in cost needed. Precision agriculture with the help of embedded systems becomes more efficient, intelligent and steady by using LPC2148, Temperature sensor, Humidity sensor, Dry/wet sensor to detect the soil moisture condition automatically and 16X2 LCD is used to display their values with the help of in built Analog to digital converter and the people can access the information of sensors with the help of simple SMS by using GSM technology.

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