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SOIL MONITORING AND IRRIGATION SYSTEM BY USING ARM PROCESSOR

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Abstract - *Agriculture is the backbone of Indian economy. The continuously increasing population in India demands for the fast development in food production technology. Water is the main resource for agriculture. Therefore efficient water management of fresh water resources and proper utilization of available water resources has a crucial importance. To save the water and to increase the yield of crop proper method of irrigation by drip is very economical and efficient. This paper presents a fully automated drip irrigation system which is controlled and monitored by using ARM7 processor. Sensors are used to monitor the moisture content of the soil and depending on that the valves of the system are turned ON or OFF automatically for different interval of time. pH of the soil is also important factor to be considered as it affects the nutrient availability in the soil. Sensor to detect the pH of the soil is used and depending on the value of the pH, suggestions are given to the farmer to maintain the proper pH. Humidity is also measured and monitored. Nitrogen is one of the important macronutrient in the soil. It is a essential nutrient compound for plant growth. Sensor is used to detect soil nitrogen and suggestions are given to the farmer according to requirement.*

***Key Words*: ARM7, GSM module, LCD, MQ135, FC-28-c.**

1.INTRODUCTION

In many agricultural cropping systems irrigation is necessary. In semiarid and arid areas, efficient water applications and management are of major concerns .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. Large amount of water goes waste due to improper water usage. The demand for new water saving techniques in irrigation is increasing rapidly right now. The aim of farmer is to produce "more crop per drop", Hence there is need to find the irrigation techniques which consumes less fresh water. These techniques are helpful in the regions where there is a scarcity of fresh water. 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 from time to time. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. Water deficiency can be hazardous to plants before wilting becomes visible. This problem can be perfectly solved if automatic controller based drip irrigation system is used in which irrigation will take place only when there is intense requirement of water. This system uses valves to turn ON or OFF automatically. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for irrigation. It also helps in removing human error in adjusting available soil moisture levels and to maximize their net profits. The other important resources to the crop are the nutrients. If the nutrients are available in the right amount for the growth of crops then the yield of the crops also increases. Thus the productivity can be raised with the proper management of water resources and nutrients. Along with the nutrients and water resources soil pH and humidity are also important factor to be considered for better production.

2. OBJECTIVE OF THE DESIGN

Conserve energy, water resources and man power in agricultural sector. Handle the system automatically as well as manually. Detect different parameter of soil like moisture, temperature, humidity, pH and nitrogen. Build a system which enhances crop productivity. To design, build and test the system which will be economical, efficient and effort reducing of the farmer.

3. SYSTEM ARCHITECTURE

The system is design in which the different soil components like moisture, nutrients, pH, humidity and temperature are measured and monitored continuously. Also the information is sent to the user through SMS by using GSM module. The database is also maintain by the system. All the parameters of soil are sensed and the values are stored in database for analyzing how the system is functioning. Different sensors are used to detect the different parameters of the soil like moisture,

temperature, humidity, pH of soil and nitrogen content of the soil. Depending upon the sensors output the ARM7 processor will take the necessary action. ARM7 is the heart of the system all the controlling actions will be done by the processor. The moisture sensor output will guide us whether to irrigate the land or not depending upon the moisture content. Along with moisture sensor the temperature sensor output is also important and has to be taken into consideration while irrigating the land. If the moisture content of soil is very low and the temperature is very high then there is need of irrigation for plants, but the time for which irrigation will be provided is different for different temperature range. If the temperature is very high then the evaporation rate is also very high and hence we have to provide water for more time in order to attain the proper moisture content level in the soil. Hence for different temperature range and moisture content level in the soil the land will be watered for different time interval. pH of soil is also detected and measured. It is also important factor which will affect the plant growth. Acidic or basic nature of the soil will affect the nutrient content in the soil.

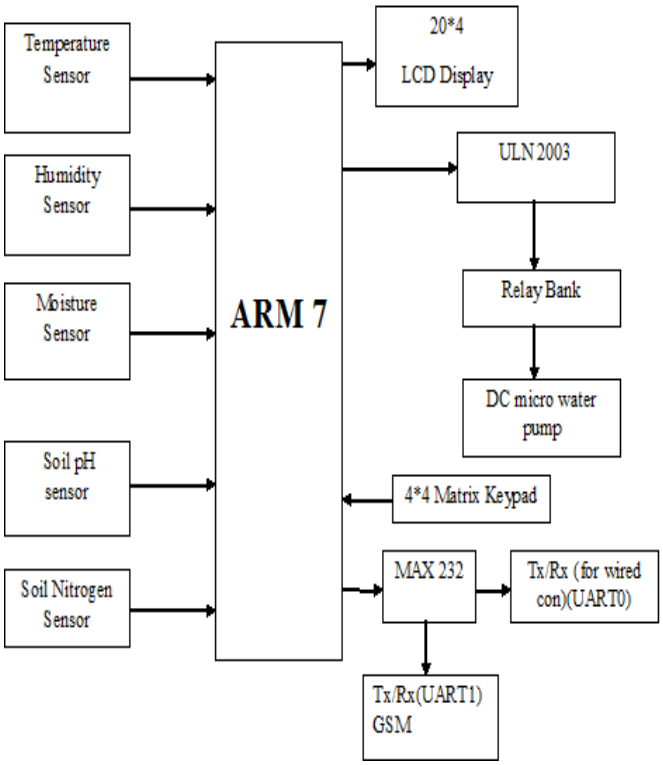

Fig -1: System Block Diagram

Soil nutrients i.e. macronutrients or micronutrients are helpful for plant growth and there availability depends on the pH of the soil . Hence there is need to measure soil pH. Depending upon the pH measured suggestions can be given to the farmer to add various chemicals to achieve the required pH of the soil for good plant growth. Nitrogen is one of the vital macronutrient which is required for plant. Nitrogen is also measured and depending upon the nitrogen percentage the decision is taken whether to provide fertilizer to the soil or not. In the system LCD display is used to display various measured parameter of the soil and also the required suggestions. Solenoid valves are used in the system which are controlled through the relay bank. The data is transmitted wirelessly by using GSM module and the data is fetched by using PC and database is maintain which will be used for analyzing purpose. The keypad is used to choose the soil type in which the system will work and accordingly we can set the threshold points. Keypad is also used for manual operation. Thus the system will help to monitor, control and communicate. The system consist of following block

3.1 Sensors

Sensors are the device which converts the physical parameter into the electric signal. The system consists of temperature, humidity, moisture, soil pH and soil nitrogen sensor. The output of sensor is analog signal; the signal is converted into digital signal and then fed to the processor. The temperature sensor is used to measure the temperature of the soil. Here LM35 temperature sensor is used. The output voltage of sensor is linearly proportional to the Celsius (Centigrade) temperature. The humidity sensor is used to measure the environment humidity. SY-HS-220 is used as a humidity sensor module. The relative humidity is converted to the output voltage which is the required output. The moisture sensor is used to measure the moisture content of the soil. Copper electrodes are used to sense the moisture content of soil. The conductivity between the electrodes helps to measure the moisture content level. The pH sensor FC-28-c is used to determine the pH of the soil. The nitrogen sensor MQ135 is used to measure the nitrogen content of the soil.

3.2 ARM7 Processor

The ARM7TDMI-S LPC2148 is used as a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles and the instruction set and related decode mechanism are much simpler than those of micro-programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S 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 a 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. 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.

3.3 GSM unit

GSM (global system for mobile communications) is the most popular standard for mobile telephony systems in the world. . SIM900 Quad-band GSM / GPRS device, works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry, which allows User to directly interface with 5V Microcontrollers (PIC, AVR, Arduino, 8051, etc.) as well as 3V3 Microcontrollers (ARM, ARM Cortex XX, etc.). The baud rate can be configurable from 9600- 115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The GSM modem is interfaced to UART1 of ARM-7.

Features:

1. .Input Voltage : 5V to 12V DC
2. Frequency Bands: SIM900A Quad Band GSM/GPRS : 850 / 900 / 1800 / 1900MHz
3. Built in RS232 to TTL or vice versa Logic Converter (MAX232)
4. Configurable Baud Rate
5. SMA (SubMiniature version A) connector with GSM L Type Antenna
6. Built in SIM (Subscriber Identity Module) Card holder
7. Built in Network Status LED
8. Inbuilt Powerful TCP / IP (Transfer Control Protocol / Internet Protocol) stack forinternet data transfer through GPRS (General Packet Radio Service)
9. Normal Operation Temperature : -20 °C to +55 °C
10. GPRS multislot class 10/ class 8 (optional)
11. Supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4
12. LDB9 connector (Serial Port) provided for easy interfacing

4. SOFTWARE

4.1 KEIL µ VISION (IDE)

Keil an ARM company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251 and 8051 MCU families. When starting a new project simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options. The Keil ARM tool kit includes three main tools, assembler, compiler and linker. An assembler is used to assemble the ARM assembly program. A compiler is used to compile the C source code into an object file. A linker is used to create an absolute object module suitable for in-circuit emulator.

4.2 GUI software

To design the graphical user interface Visuals studio 2008 is used. The data transmitted serially through UART0 is fetched by PC and is displayed by using GUI interface. The database is also maintained by SQL server 2005. Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows super family of operating systems, as well as web sites, web applications and web services. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code. Visual Studio 2008 features include an XAML-based designer (codenamed *Cider*), workflow designer, LINQ to SQL designer (for defining the type mappings and object encapsulation for SQL Server data), XSLT debugger, JavaScript Intellisense support, JavaScript Debugging support, support for UAC manifests, a concurrent build system, among others. It ships with an enhanced set of UI widgets, both for Windows Forms and WPF. It also includes a multithreaded build engine (MSBuild) to compile multiple source files (and build the executable file) in a project across multiple threads simultaneously. It also includes support for compiling PNG-compressed icon resources introduced in Windows Vista. An updated XML Schema designer will ship separately some time after the release of Visual Studio 2008.

5. CONCLUSIONS

The main objective is to design a fully automated drip irrigation system. The system provides a real time feedback control which monitors and controls all the activities of drip irrigation system efficiently. The system valves are turn ON or OFF automatically depending upon

the moisture content. The system also provides the efficient information regarding the soil pH and soil nutrients like nitrogen along with the proper suggestions. The system also provides the communication interface. GSM interface helps to provide field conditions to farmer via SMS. The data collected by the system can be sending further for analysis purpose. Thus the system monitor, control and communicate. Using this system, one can save manpower, water to improve production and ultimately increase profit.

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