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Research Article

Real Time Microcontroller Based Remote Water Monitoring System in Agriculture

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Abstract: In the present world, the application of remote monitoring can be found everywhere. Actually it reduces the human labor and enhances the field where it is applied. In recent days, the agriculture system is so advanced and fast that it requires the automatic system for the control over the agriculture field. Watering the farming land is one of the most important operations in the agriculture. Manual operation for watering may cause a wrong measurement of amount of water supply. So, to supply the water in a correct and prescribed amount regarding to how much water is available in the soil, the automation is required. The system described in this paper is incorporated with the ability of determining the amount of water in soil and depending upon the amount it will supply water into the farming land if it down to the lower limit and stop the supply when it crosses its highest limit as predefined by preset value. The system can be operated both in automatic and manual mode so that the super control can be obtained from this system to the farmers. Through the system, the watering of the farming land can be controlled from a remote place without going to the site.
Keywords: Real Time system, Water monitoring, Microcontroller, Sensor, Agriculture.

INTRODUCTION

In agriculture, one of the most important job is to watering the farming land. Most of the farmers use the manual control over the land that is to monitor the pumping or watering the land by visiting the site. This will surely need more and more labor and as a result the efficiency of work may be degraded. An automatic system can be developed to monitor all the controlling operation. Automatic control system reduces the human labor and increase the efficiency of the corresponding work. In this paper, an automatic control system is introduced for watering the land by measuring the humidity or in other word the temperature. The system measures the humidity of the soil and depending upon the condition it will provide the needed water in the land [1-2].

There are a number of systems introduced to enhance the agriculture system by providing it with various autonomous control systems. The agriculture technique has been developed day by day all over the world and so the agriculture engineering has been enhanced gradually to serve the world with more integrated and efficient system [1-4,7].

The system prescribed here is simulated and installed successfully. It will sense the humidity in a continuous fashion. There is a sensor included in this system which senses the humidity and sends the record to the Microcontroller [1-2, 4, 6, 8]. The pumps are connected with the system via relay circuit. There are two conditions are set in between which the pump will be ON or OFF. When the water supply is needed, Microcontroller sends an analog pulse to the system to enable the relay circuit and the water will be supplied till the time the pump will be ON[1-2, 4].

So, in this system no manual labor is there to control the overall process. The detailed operation of the system will be discussed in the next section along with the system components and the algorithm.

REAL TIME MONITORING SYSTEM

The real time monitoring system means the system that will control some operation will be implemented in a hardware fashion. Real time water monitoring system is based on microcontroller environment and sensed by humidity sensor. The essential components and the operation of the system is described in this section [2-4,6-7,13].

Components
The main components are stated and described below:

i) Microcontroller

This is the main component which makes control over the system. The main operation of the Microcontroller is to receive the pulse from the humidity sensor and sends the required direction to the relay system for pumping operation to be started [1,3,4,7].

ii) Capacitive Humidity Sensor

It senses the humidity of the soil continuously. The sensed condition is given as the input to the microcontroller will give the signal to relay using RS232 serial communication protocol which drives the water pump. If the sensed range is true for pumping, the system will supply water in the agriculture ground [4,6-9].

iii) Analog to Digital Converter

The humidity sensor sends the analog pulse to the system. But to read the condition, Microcontroller needs an Analog to Digital Converter. MCP3202 IC is used in this system to obtain the digital format of the condition that is checked by the sensor. MCP3202 is a successive approximation 12-bit Analog-to-Digital (A/D) Converter with on-board sample and hold circuitry. The MCP3202 is programmable to provide a single pseudo-differential input pair or dual single-ended inputs. Differential Nonlinearity (DNL) is specified at ±1LSB, and Integral Nonlinearity (INL) is offered in ±1LSB (MCP3202-B) and ±2LSB (MCP3202-C) versions. The MCP3202 device operates over a broad voltage range (2.7V-5.5V). The device is capable of conversion rates of up to 100ksps at 5V and 50ksps at 2.7V [1, 4, 7-9, 11-12].

Operation

The overall objective of the system is to indicate the status of humidity of the soil and to automatically control the water supply to the land in order to prevent the dry condition for the soil. The sensed condition is given as the input to the microcontroller through Analog to Digital Converter and based on the condition the microcontroller will give the signal to relay which drives the water pump for watering. The system incorporates with a LCD screen which displays the condition of the soil.

The water of the soil of the land, when evaporated, the land gets dried up. The prescribed system can identify the water availability condition of the soil and to automatically control the water supply to the land from a remote place to prevent it to be dried up.

In this automatic system, embedded technology is used in order to achieve the good profit in the agricultural field the soil should be maintained in proper condition that fits for the crop cultivation. The main thing that should be seen in order to achieve the profit is to maintain the wet condition of the soil in the correct proportion.

The sensor is placed in the soil and it reads continuously the levels of the moisture or amount of water available in the soil. There a prescribed range is preset in between which the sensor gets an ignition for its operation. When it reads the lower level of the humidity or more specifically the relative humidity (RH), it sends a pulse to the ADC informing that the level of the amount of the water in the soil goes to minimum and this analog signal is then converted to its corresponding digital format and get routed by the modem MAX232 IC to the Microcontroller. After receiving the signal, controller will send the signal to the relay section and make it turn ON. When the relay is turned ON, the pump will be activated and it supplies the water to the land. There is a remote controlling unit is placed in between the main controlling section and the sensor which again is controlled by the microcomputer unit. In the mean time, the sensor continues its reading the humidity and until it reaches to its maximum value of operation. While reading, the sensor continuously supply the information to the controller and controller will make switch ON the pump and the water will be supplied continuously. Now, when the sensor reads the maximum humidity of the soil, it again sends that information to the Microcontroller and controller immediately switch OFF the pump and the water supply will be turned off accordingly. The capacity of the water flow will be suitably designed by means of resizing the radius of the water supply pipe.

The entire circuit is interconnected with RS232 cable and the power supply that is needed to run the system is 5 volt. So, in this system, the agriculture ground can be monitored from a remote place without going there and the soil water level can be maintained accordingly [1, 3, 6, 13].

HUMIDITY MEASUREMENT

Water supply is required in the agriculture ground when the soil contains lesser amount of water. When the temperature in the air increases, the capability of air for holding the water vapor will be increased. This means the temperature rise in air causes more vaporization in the air from soil. So, it is obvious the amount of water in the soil will be decreased [1, 2, 4, 7, 9]. The humidity sensor senses the amount of the water particle or humidity of the soil. The humidity sensor, mentioned above, is actually senses the present humidity i.e. the Relative Humidity (RH). The relative humidity is actually the ratio of actual vapor present to the saturation vapor amount and can be represented by the equation mentioned below [2, 4, 8-10, 12].

$$\text{Relative Humidity}=\frac{\text{Actual Vapor Dendity}}{\text{Saturation Vapor Density}}\times 100\% \quad ...(1)$$

So, the vaporization or in other word the relative humidity is inversely proportional to the temperature rise of the air as well as the actual humidity of the air as because the actual humidity is directly proportional to the temperature rise. These are illustrated in the following equations [2, 4, 8-10],

$$\text{Actual Humidity} \propto \text{Temperature Rise} \quad ...(2)$$

$$\text{Relative Humidity} \propto \frac{1}{\text{Temperature Rise}} \quad ...(3)$$

$$\text{Relative Humidity} \propto \frac{1}{\text{Actual Humidity}} \quad ...(4)$$

There are two fixed values of humidity sensor, monitored by the controller, which totally control the supply and flow of the water into the agriculture ground. When RH is low, it indicates high temperature and so the vaporization into the air will be increased [2, 5,6, 9, 10, 13]. Then the relay will be turned ON and the water will be supplied into the ground. While supplying the water into the ground, the amount of water will be increased in the agriculture ground meaning that the humidity in the soil will be in increasing mode. In the highest preset value of the sensor, it indicates the lower temperature or in the other hand the vaporization is low as the amount of the water in the soil is in the highest level. Then the relay will be turned OFF and the water supply in the soil will be halted. After some time when the vaporization is increasing, the system will iterate in the same way and then it continues the water supply.

Thus, this system, by sensing the relative humidity, will work without interruption and efficiently. As the sensor in the ground is connected with the central through the cable, it can be efficiently monitored from the remote place.

BLOCK DIAGRAM

The block diagram of the system including the main controlling unit, remote controlling unit and the sensor part is shown in Fig.1

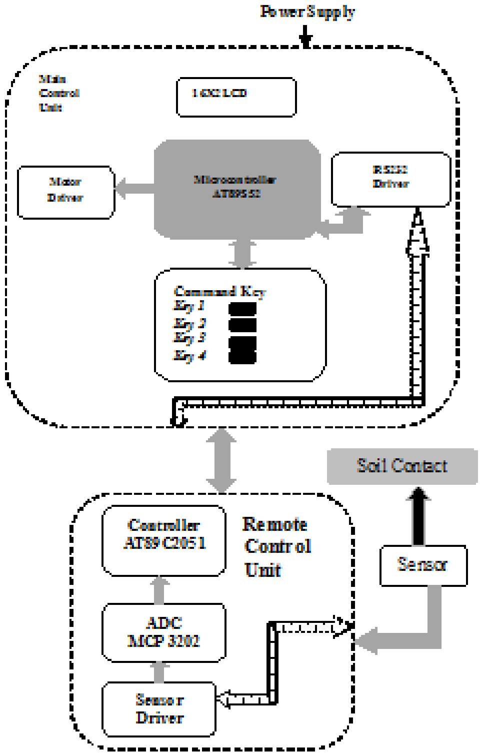

Fig. 1 Block diagram

In this block diagram, there are mainly three working blocks and they are:

1. Main Control Unit (MCU)
2. Remote Control Unit (RCU)
3. Sensor Unit (SU)

In the MCU, there are microcontrollers, LCD driver, motor driver, cable driver and the command key are internally connected. The signal coming from RCU is received by the cable driver through RS232 cable and sent to the Microcontroller. The humidity is displayed in the LCD screen and with the command by the Microcontroller the motor driver is enabled. The Command key is one of the important parts of the system. The total system can be operated automatically or manually. Among the four keys, one is used for automatic operation and rests three are for manual operation. That means when agriculture process is going on, the automatic mode is suitable for that purpose but for when it is not needed i.e. water need not to be supplied to the ground, the manual mode is suitable as one of the mentioned three keys is the STOP key to stop the entire operation.

In the RCU, the controller, ADC and the Sensor driver are internally connected. The humidity sensed by the sensor, is received by the sensor driver and converted to its digital format by the ADC and sends it to the controller. The controller sends the digital data to the MCU.

ALGORITHM FOR REMOTE SOIL MONITORING

Remote soil monitoring system works on the principle of checking the amount of water in the soil and thereby activating the pump when required. The work flow of the system is represented in Remote Sensed Monitoring (RSM) algorithm.

Pseudo code:

Select mode (M): M_1 or M_2;
if $M == M_1$;
Switch K_1;
K_1=="1";
do
Check water amount in soil (W_{soil});
Display W_{soil};
Check the preset values: $P_{least}, P_{highest}$;
for $W_{soil} == P_{least}$;
$S_m ==$ "1"// S_m =Status of motor driver
until
$W_{soil} == P_{highest}$;
if $W_{soil} \geq P_{least}$ && $W_{soil} < P_{highest}$;
Check continuously;
Control the flow;
if $W_{soil} == P_{highest}$;
$S_m ==$ "0";
repeat;
else
do
Check $W_{soil}, P_{least}, P_{highest}$;
switch K_2;
Display W_{soil};
for $W_{soil} == P_{least}$;
switch K_2;
K_3=="1";
S_m== "1";
until
$W_{soil} == P_{highest}$;
if $W_{soil} \geq P_{least}$ && $W_{soil} < P_{highest}$;
K_3=="1";
S_m== "1";
Check continuously;
Control the flow;
if $W_{soil} == P_{highest}$;
switch K_4;
K_4== "0";
S_m== "0";
repeat;

Through the RSM algorithm, the system can be monitored automatically or manually both when needed.

OPERATIONAL FLOW CHART

The pseudo code describe in the above section is represented in a flow chart form in this section. Flow chart is helpful in implementing the actual system. In this flow chart, the operation and the mode selection along with the pump operation and the relay operation is completely described.

In Automatic mode of operation, only one key is required to be pressed for activation and then the mode will work according to the direction given to it. If the automatic mode faults in some critical condition, the manual operation will be in operation. So, in this system, there is a lesser chance to get a fault for operation and hence can be operated efficiently.

The flow chart is constructed in E-draw v6.8 where a number of process box, control box and all the other boxes that are mainly required for constructing the flow chart are readily available. The flow chart is shown in Fig.2.

In this flow chart, the switching and control operations are described clearly so that a system can be constructed easily. The main advantage of the design the flow chart in E-draw is that the flow chart is much more clear and significant than any other drawing tools and it produces the output with a lesser size so that it can be fit in the required space and have no problem with the fitness.

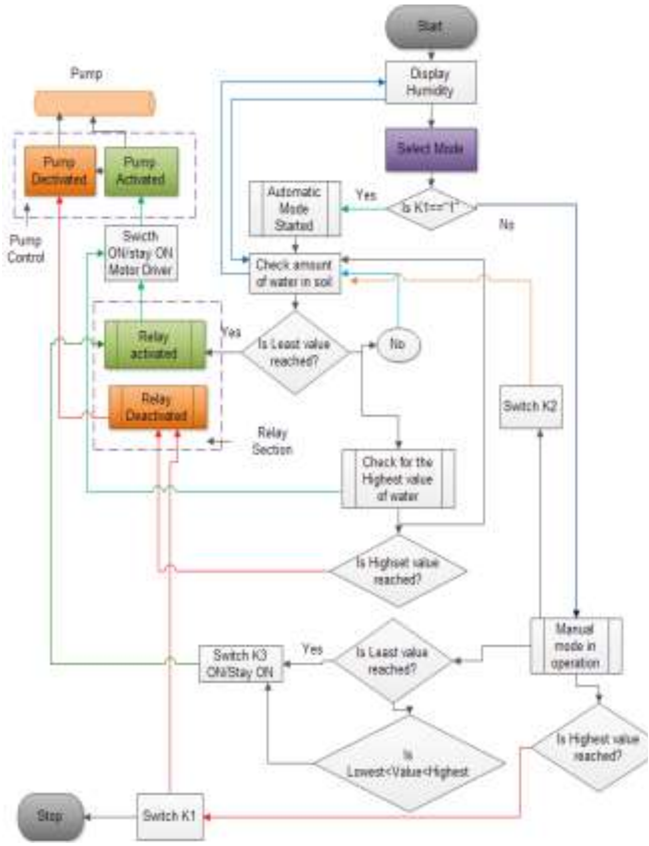

Fig.2 Flow chart of RSM Algorithm

SYSTEM HARDWARE

The system hardware that is the main system PCB includes several parts or blocks such as the Display section, Transformer section, Relay section, Sensor section etc. Those sections are given below.

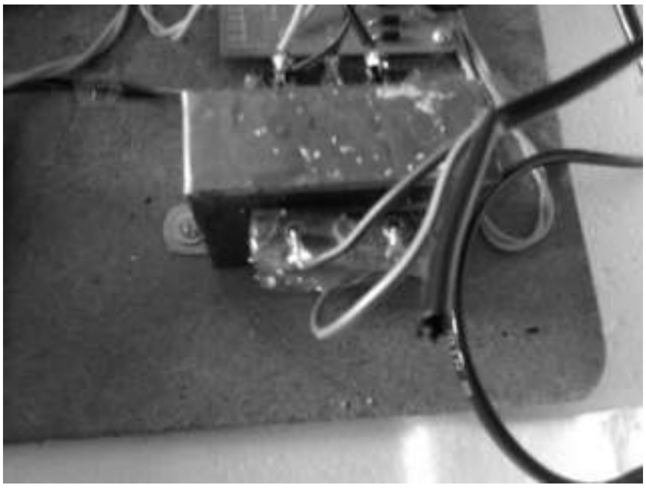

Fig. 3 Transformer Section

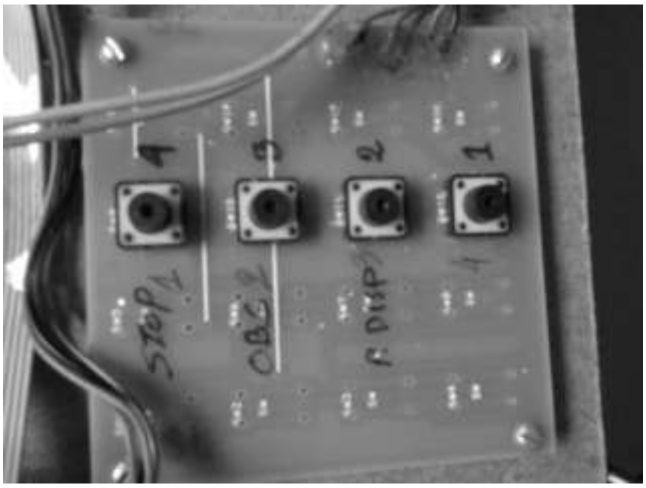

Fig. 4 Keyboard Section

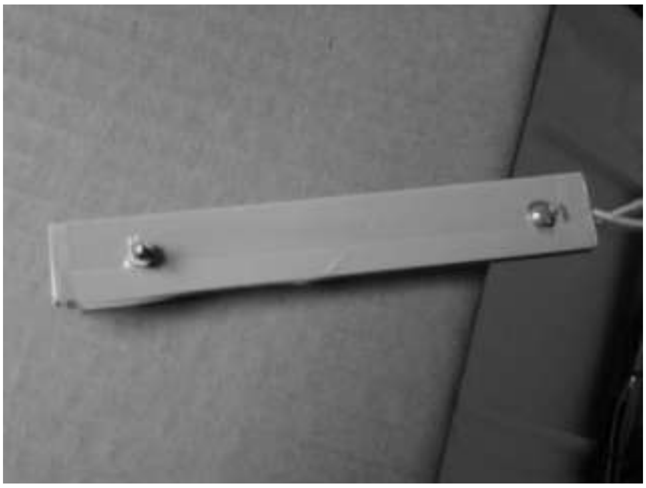

Fig. 5 Sensor Section

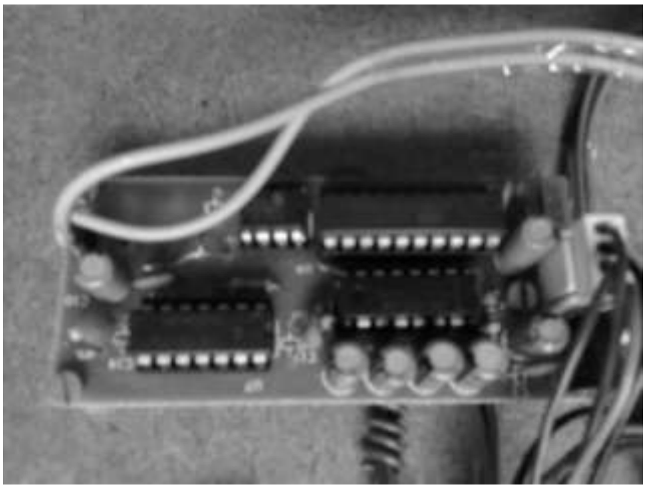

Fig. 6 Remote Controlling Section

Fig. 7 Display Section

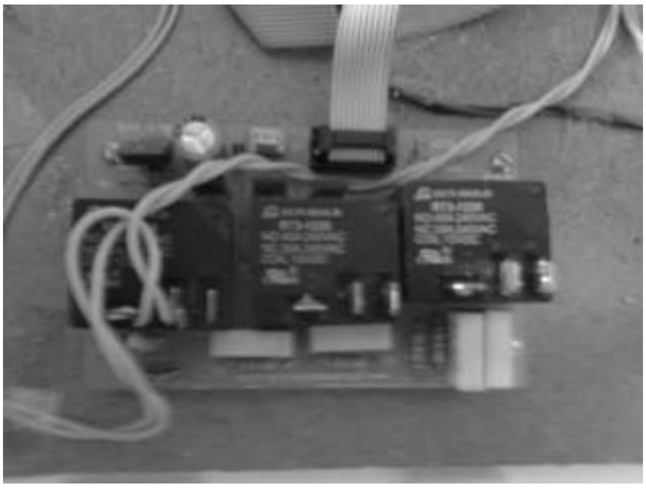

Fig. 8 Relay Section

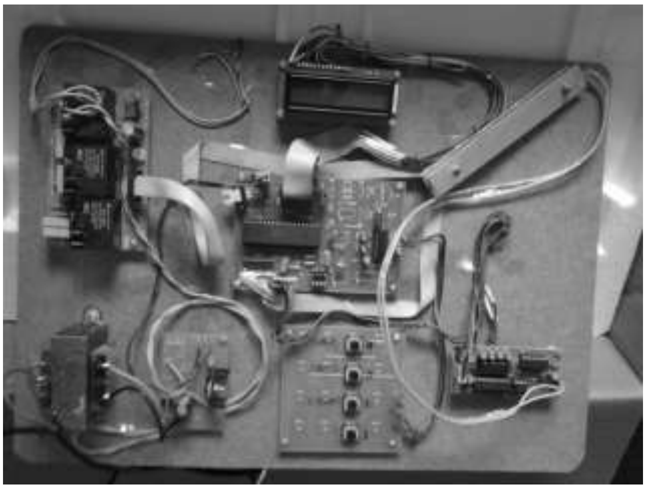

Fig. 9 Complete System Circuit

SOFTWARE ENVIRONMENT

Any circuit is needed to design in the software first to check the response of the generated system. The system is first designed in Proteus 7 and the assembly code that is required for simulation of the circuit, is written in Keil C or in other word Embedded C. The HEX code generated by the Keil C is given as the input to the Microcontroller in the Proteus circuit and it gives the desired result as mentioned above.

The system is actually an embedded system meaning the whole system is run by a single source of voltage from the transformer. So the system design and the code writing will be must in the embedded environment only to simulate it properly.

OUTPUT RESULT OF SYSTEM

The system checks the status of the water in the soil and display it on the LCD device and based on the true condition, it stats the relay as well as the pump to supply water. The output condition of the system is depicted below.

When the RH of the soil is below the preset value it will activate the motor as well as the pump and display the RH on the LCD along with the information that the pump or the motor is ON.

Fig. 10 LCD Displays the lowest preset value of RH

Fig. 11 Motor turned ON for lowest preset value of RH

Now the sensor will check for the range of the lowest and highest preset values of the RH and go further for highest value. Meanwhile it continues the activation of the motor. So in between the lowest and the highest value of RH, the motor is enabled and continues the supply of the water. When the RH value reaches the highest condition, it will automatically turn OFF the motor and the water supply will be terminated.

Fig. 12 System checks for the highest preset value of RH

Fig. 13 Motor is turned OFF for highest preset value of RH

FUTURE SCOPE

In the recent days the agriculture is very much developing and so the farmers also need some special feature of the systems that are currently used for it. Automatic pumping system is one of the useful systems in the agriculture. It will supply water just when it is needed. So, one part of labor can be operated by the machine itself and so the efficiency of the farming will be increasing and as the system is dependent on the RH value of the soil, so there no overflow or underflow of water in the agriculture ground.

The system can also be used apart from the agriculture. The remote sensing has a broad application in the world. Each and everywhere the remote sensing operation can be found. In aerospace, for signalling for advert weather or in some critical condition, it can be used for automatic operation. For traffic system, the RSM algorithm can work efficiently. This system can be applicable for in-house maintain system also i.e. for in-house monitoring of different electrical or electronics parts i.e. Fan, Light etc. The moisture level can also be detected of an particular remote area apart from the soil testing and can be indicated by the display so that one can aware of the local moisture level as well as the relative humidity an also the dew point.

CONCLUSION

In conclusion, it can be said that the system reduces the human labor in agricultural field and enhance the production by supplying the water into the ground. The system can be enhanced to create a complete monitoring of the agriculture ground by supplying different materials such as the fertilizers into the ground and thus by reducing more and more human efforts for cultivation.

REFERANCE

1. Yi Qi, Philip E; Dennison JS, David R; Monitoring live fuel moisture using soil moisture and remote sensing proxies. Fire Ecology , 2012; 8(3):71-87.
2. David LB, Tian G, Tim R, McVicar, Qin Yi, Li F; Soil Moisture and Drought Monitoring Using Remote Sensing, Final Report Australia-China Joint Science and Technology Commission Project. 1992-1997. CSIRO Australia.
3. Jirapon S, Chaiwat O; Real-time flood monitoring and warning system. Songklanakarin J. Sci. Technol, 2011; 33 (2):227-235.
4. Edward MB, Kenneth AS, John WH, Scott ML, Dennis LC, Yang C, Craig ST, Walter CB; Remote- and Ground-Based Sensor Techniques to Map Soil Properties. Photogrammetric Engineering & Remote Sensing, 2003; 69(6): 619–630.
5. Jerry CR, Paul VZ, James HE; Remote Sensing Techniques to Assess Water Quality. Photogrammetric Engineering & Remote Sensing, 2003; 69(6): 695–704
6. Manchanda ML, Kudrat M, Tiwari AK; Soil survey and mapping using remote sensing. Tropical Ecology, 2002; 43(1): 61-74.
7. Morris M; Soil Moisture Monitoring: Low-Cost Tools and Methods. NCAT Energy, 2006; 1-12.
8. Swarup SM, Chaudhari DS; A Review on Smart Sensors Based Monitoring System for Agriculture. International Journal of Innovative Technology and Exploring Engineering, 2013; 2(4):76-78.
9. Grahn H; Remote Monitoring of Soil Moisture. Southwest Hydrology, 2003.
10. Garcia L, Eldeiry A, Elhaddad A; Estimating soil salinity using remote sensing data. Civil Engineering, 2000; 1-10.
11. Anderson WB, Zaitchik BF, Hain CR, Anderson MC, Yilmaz MT, Mecikalski J, Schultz L; Towards an integrated soil moisture drought monitor for East Africa. Hydrol. Earth Syst. Sci. Discuss., 2012; 9:4587–4631.
12. Wang L, John JQU; Satellite remote sensing applications for surface soil moisture monitoring: A review. Front. Earth Sci. China, 2009; 3(2): 237–247.
13. Dinesh M, Saravanan P; FPGA Based Real Time Monitoring System for Agricultural Field. International Journal of Electronics and Computer Science Engineering, 2013;1(3):1514-1519.