ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

# Precise Automation and Real Time Monitoring of Agricultural Processes using Wireless Sensor Networks

Vasantha Raghavan. N[1], Prassanna Venkatesh. B[2], Rakesh Sundar. K[3], Shyam.S[4], D.S.Purushothaman[5]

B.E Student, Dept. of EEE, Sri Venkateswara College of Engineering, Kanchipuram, Tamilnadu, India[1,2,3,4]

Assistant Professor, Dept. of EEE, Sri Venkateswara College of Engineering, Kanchipuram, Tamilnadu, India[5]

**ABSTRACT:** For the proper growth of plants various physiological and physio-chemical factors are responsible like: soil moisture, atmospheric temperature, humidity, sunlight, pH of soil, nutrient and chemical balance of soil. Biologically, these parameters are in direct relation with the process of photosynthesis, which affects the total overall growth of the plant. "Precision farming" describes a bundle of new information technologies applied to the management of large scale, commercial agriculture. It promises higher yields and lower input costs by real-time and automatic monitoring of site specific environmental and soil conditions using different sensors and thereby improving crop management, reducing waste and labor costs. An attempt has been made to develop an automated system which can measure different agricultural process parameters (like temperature, soil moisture, sunlight intensity, humidity, chemical contents etc.) and control using PID controller, these parameters can be remotely monitored and control. This prototype aims at saving time and avoiding problems like constant vigilance. This paper uses ATmega328 Micro-controller. It is programmed in such a way that it will sense all the physiological parameters associated with the plants and study the relation between them, analyze, correlate them using fuzzy control and supply the water if required. This paper aims to design a protocol for monitoring using Wireless Sensor Network (WSN). Focus area will be parameters such as temperature, humidity and soil moisture. This system will be a substitute to traditional farming method in which farmer had to visit his field regularly to examine these parameters.

**KEYWORDS:** Precision Farming, Fuzzy control, PID, Wireless Sensor Network.

## I.INTRODUCTION

Civilization began with agriculture. When our nomadic ancestors began to settle down and grow their own food, human society was forever changed. With the practice of agriculture, gradually they moved from forests and hilly areas to plains. Not only did villages, towns and cities begin to flourish, but so did knowledge, the arts and the technological services. Human communities, no matter how sophisticated, could not ignore the importance of agriculture. Agriculture is the major source of income for about three-fourth of India's rural population. Agriculture not only provides food but also raw materials for manufacturing industries like textiles, sugar, vegetable oil, etc.., Irrigation is the artificial method of application of water to the land or soil. In countries like India, the monsoons are uncertain. So irrigation is necessary to protect the crops. In agricultural sector there are lots of problem related to crop production. This paper aims to focus on some of the problems significantly faced by the farmers, which are:

a) Shortage in availability of land and water resources ;
b) Drastic change in environmental conditions due to Global Warming, etc.
c) Unnecessary use of chemical agents (e.g. inorganic pesticides, fertilizers, etc).
d) Lack of information on sustainable agriculture
e) Overuse of land, leading to land exploitation and degradation of soil quality.
f) On a broader aspect for the agro-market:
g) Production of foreign crops cannot be done here in the native farmlands
h) Seasonal plants cannot be grown throughout the year (e.g. Tulip cannot be grown in summer)

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

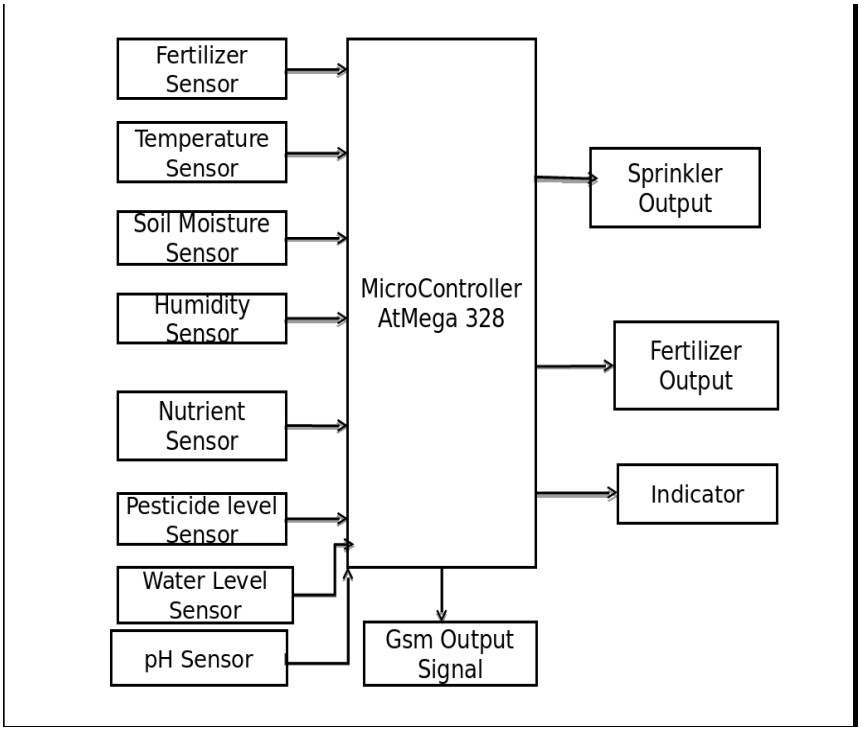
*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

## II.SYSTEM MODEL AND ASSUMPTIONS

A Precision farming system should include following basic functions:
1. Sensing agricultural parameters in real-time namely, soil parameters, environment parameters etc.
2. Identification of sensing location and data aggregation
3. Transferring the aggregated data from crop field to control station for better decision making

For this application, sensors need to be placed outside, in the open field, where power may not be available. So, sensors should be battery operated. We divide the entire irrigation land into different sectors of small size in which we integrate sensors. So, each sector has to be identified. Sensing location may be identified by integrating GPS with each sensor. Generally the monitoring station is located far away from the field; therefore, laying wires for transferring sensor data from field to control station is a costly proposition. Considering all these functional aspects and limitations in wireless nodes, low power, low data rate wireless sensor network is used. The proposed hardware block diagram is shown in below fig 1. The relation between various parameters (viz temperature, soil moisture, humidity) are related through fuzzy logic controller whereas overall relation between all the sensors are controlled through PID controller.




## III.SIMULATION RESULTS

**PID Control Algorithm:**MATLAB Simulink is helpful in modeling real time processes. PID control is implemented for process parameters such as temperature, moisture, humidity, sunlight intensity and pesticide level control etc. Simulink block for PID controller is shown in fig 2 and output of the scope can be viewed in fig 3. Simulink block has been created in accordance with the below formula.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

Fig 2. Simulink Process Block of PID Control:-

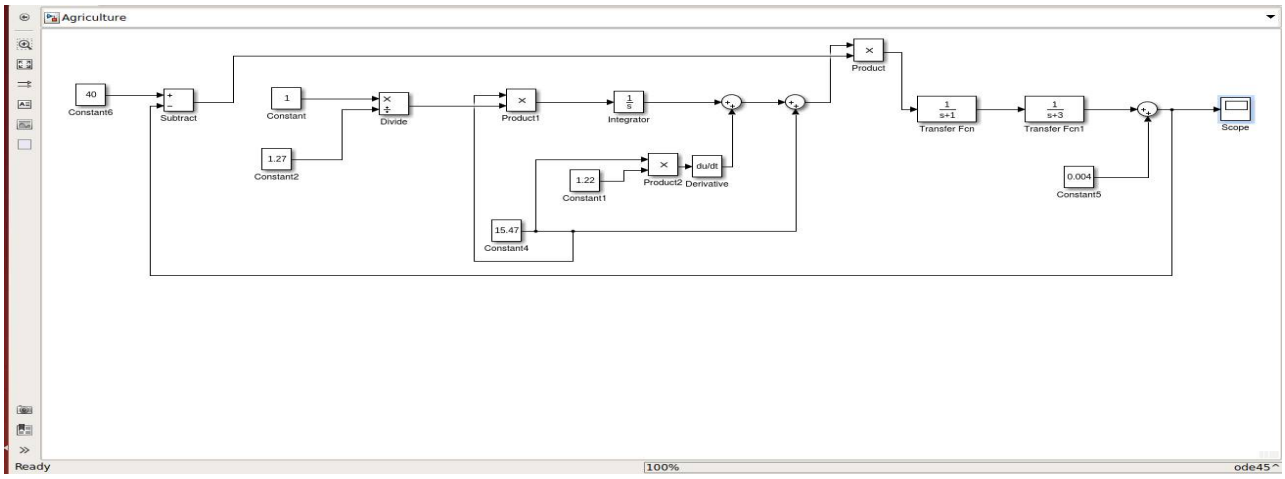
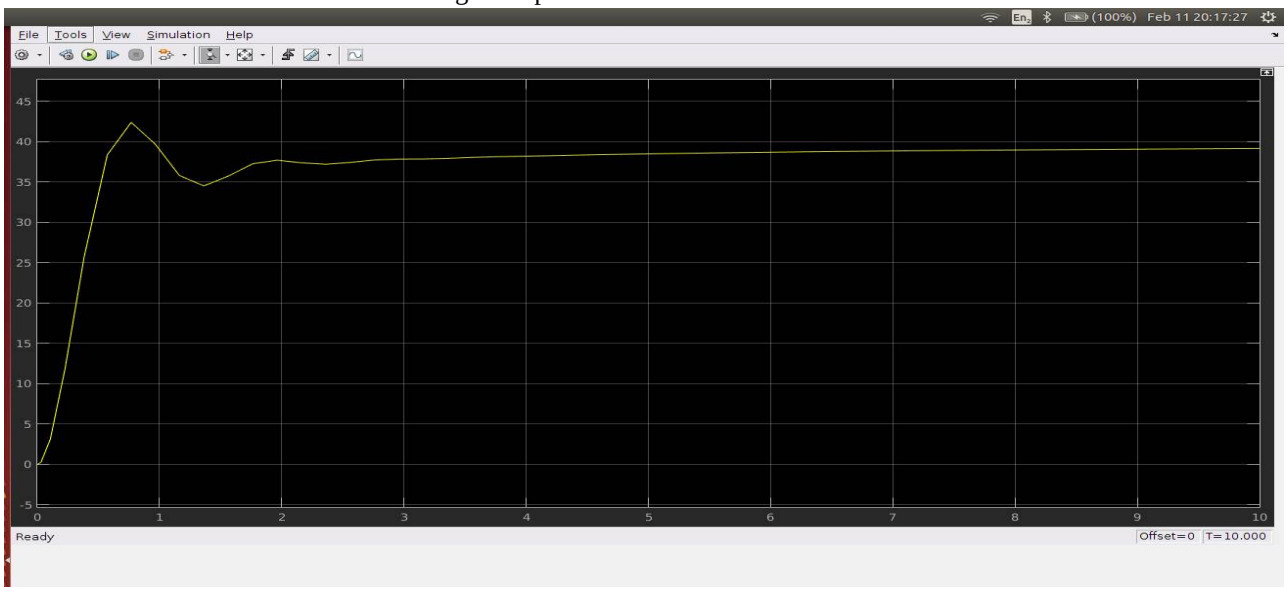



Fig3. Response of PID Control:-




By setting up proper values for Kp,Ti,Td etc the temperature and moisture level values are controlled which helps in achieving our objective of automation and real time monitoring. PID control gives best results and helps in achieving our goal of precise automation by modeling and controlling both input and output parameters.

| S.NO | Temp | Kp(Gain) | Ti | Td | Settling Time |
|---|---|---|---|---|---|
| 1. | 40 | 15.47 | 1.27 | 1.22 | 2.5 |
| 2. | 50 | 17.22 | 1 | 1 | 2.5 |

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

## IV.INDIVIDUAL MODELLING OF EACH SENSORS

Individual modelling and simulation of each sensors helps in identifying the characteristics and operation of each sensor individually. With values of power levels of each individual sensor the overall objective of power automation is achieved. Number of sensors can be modelled and its output can be viewed in scope. Here, four sensors (namely temperature, moisture, humidity, sunlight intensity) are modelled in the below Simulink block in fig 4. The output of scope1 can be viewed in fig 5. The block is modelled with a random source. The random source generates variable levels of input voltages. The range of voltage can be changed in accordance with actual range values of the sensors as from the datasheet values. With the help of wide range of values the output obtained from various conditions like 'humidity' from the field can be simulated and the control block can be modelled in a proper way such that high efficiency is obtained. An Analog to Digital Converter is employed which converts the analog voltages into digital values and the output is viewed in scope block. Usually the output values from sensors are analog values, so an ADC is essential before interfacing with a microcontroller. The microcontroller is interfaced with digital values of the sensors. A transport delay is provided due to switching time which exists in the sensor and also from the ADC block which can be viewed from scope1 block.

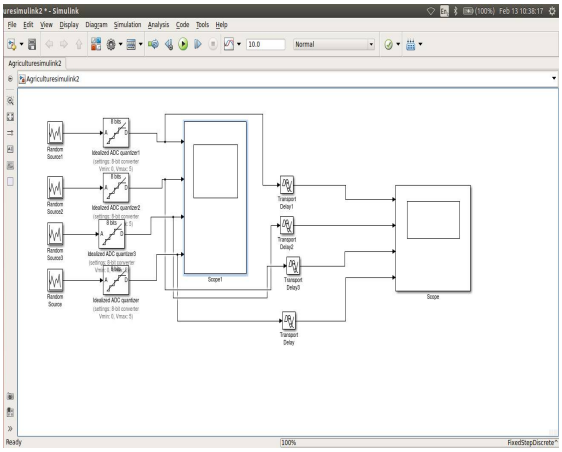


**Fig 4. Simulink block of sensors**

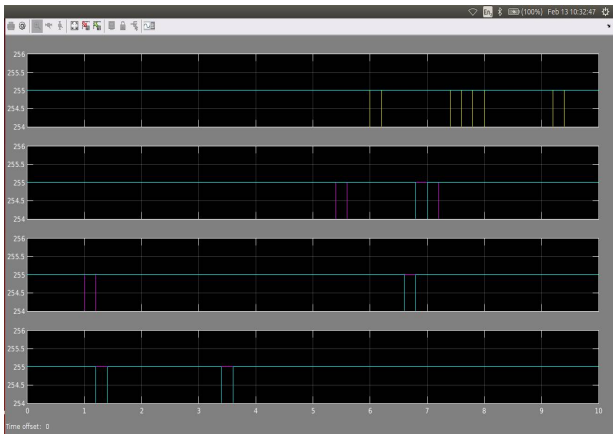


**Fig 5.Response of sensors**

## V. FUZZY LOGIC CONTROLLER

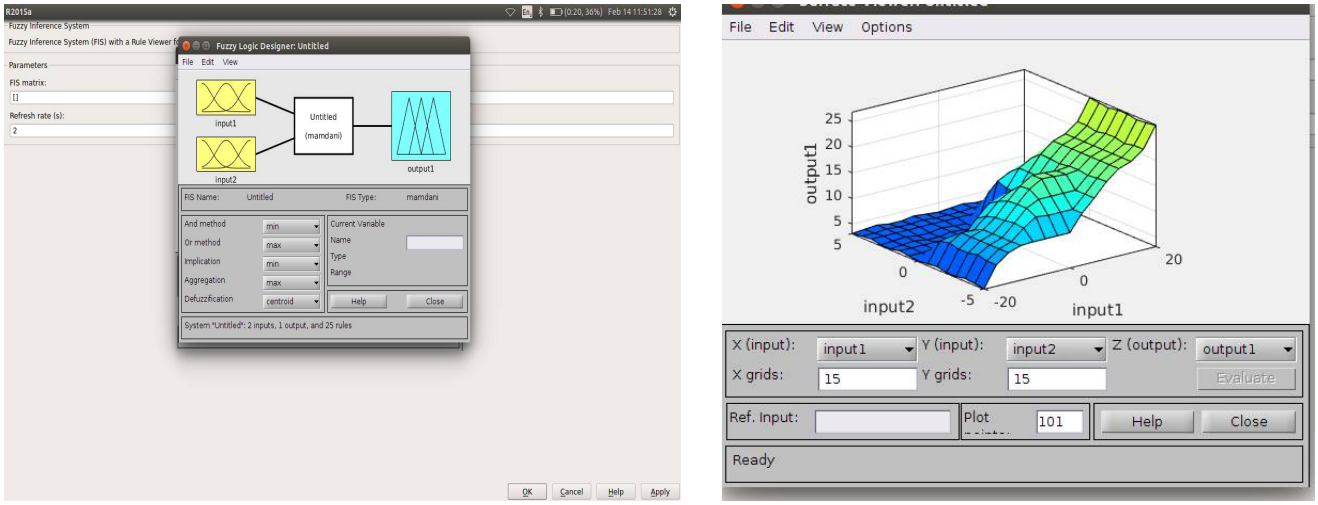
Since various relations exist between different parameters, the values from these parameters are formulated using fuzzy logic and hence fuzzy logic controller is enabled. Fuzzy logic controller with 2 inputs and 1 output with mamdami system is simulated in Simulink process block. Each input has 5 membership functions and output has 4 membership functions. The membership functions are triangular in shape. **The fuzzy domain is (-4, -3, -2, -1, 0, 1, 2, 3, 4);NB = negative big, NS =negative small, Z = zero, PS = positive small, PB = positive big. Assume that changes in humidity around 20%, the basic domain of deviation humidity is [ − 20, + 20].** Defuzzification using centroid or any other options gives the perfect output. Single spike is used in output for good response during defuzzification. In this model **25** rules are defined with the above defined functions to model the output and fuzzy range of output values corresponding to two inputs are obtained.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**



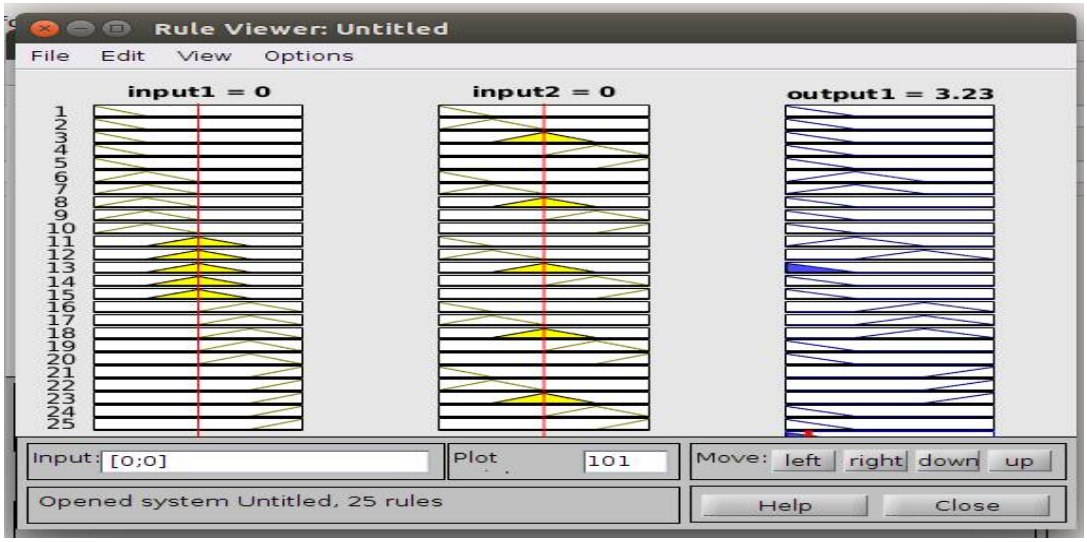




**Fig7.Mamdani control, Ruler Viewer and Surface Plot**

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

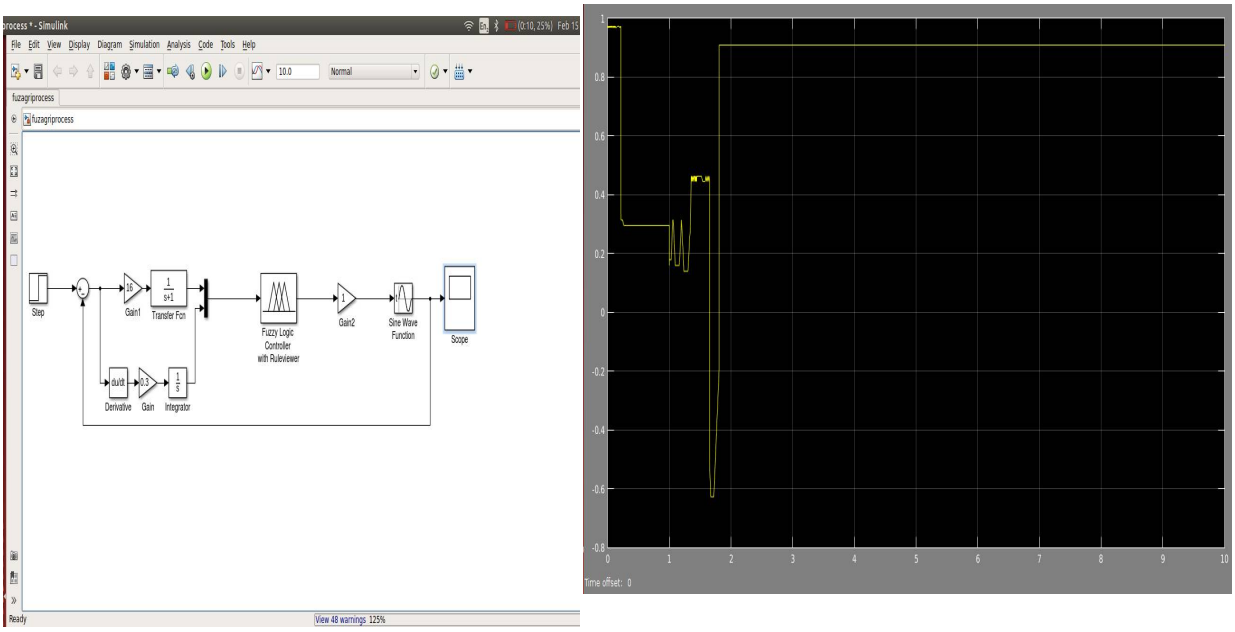



**Fig.8 Simulink block and Response of Fuzzy Logic Controller:-**

## VI.HARDWARE RESULTS AND OUTPUT VALUES

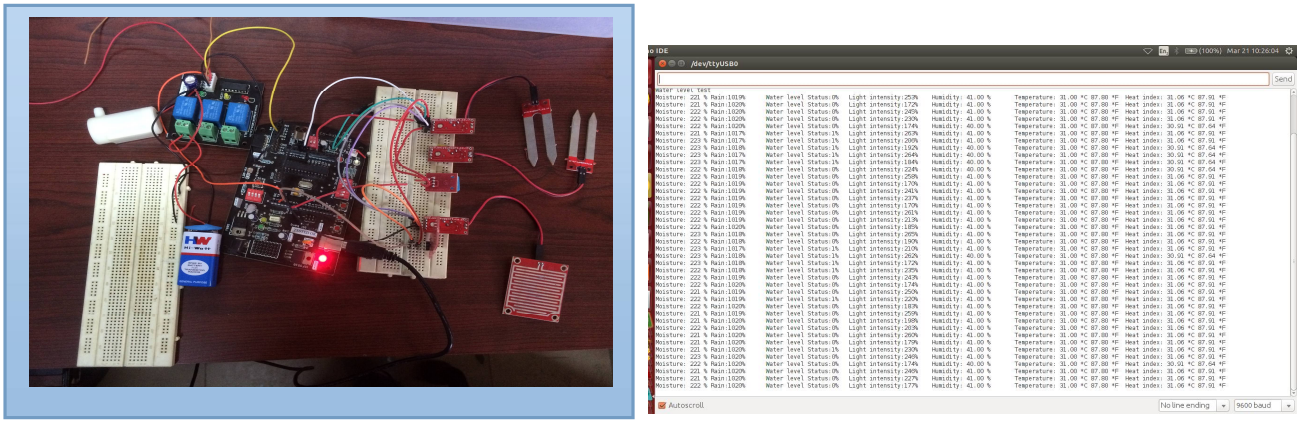


**Fig 9. Hardware Implementation and Results**

The various sensors for soil moisture, temperature, humidity, sunlight intensity ,weather conditions, water level indicator are interfaced with Atmega 328 micro-controller and its is shown in the above fig 9.A. The parameters such as soil moisture value, weather condition, temperature, humidity, water level, light sensitivity ,heat index are shown in the the Fig 9.B

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Special Issue 5, March 2016**

## VI.CONCLUSION

Crop irrigation control is the most important concern in the domain of agriculture. Shortage of water globally is also emphasizing the need of these systems that not only control the crop irrigation but also provide an intelligent way of providing water to places where it is needed and in precise quantity. By monitoring soil moisture, Leaf wetness, Temperature, Relative Humidity, Plant Root Depth, Sand Texture, Water Storage Capacities of soil, Plant water usage capabilities, we can make efficient use of water resources and also achieve higher yield with reduced inputs. In this paper, we propose a system in which the exact information regarding environmental conditions are sensed and with effective use of wireless sensor networks, optimum use of resources is achieved. This system helps the farmer to remotely monitor the parameters such as soil moisture, sunlight intensity, weather conditions, fertilizer content, nutrient level in isolated zones. Thus we conclude that, by using this proposed technique, we get the following advantages:-

**1.Increased irrigation efficiency**
**2.Reduced labor cost**
**3.Optimum utilization of water resources and electricity.**

## REFERENCES

[1]Bansari Deb Majumder, Arijita Das, Dibyendu Sur, Susmita Das, Avishek Brahma, Chandan Dutta, "Development of Automated Agricultural Process Monitoring and Control Technology in an Enclosed System" , IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) (Apr. 2015)
[2]Siuli Roy, Somprakash Bandyopadhyay, "A Test-bed on Real-time Monitoring of Agricultural Parameters using Wireless Sensor Networks for Precision Agriculture"
[3]V. Devika, Sk. Khamuruddeen, Sk. Khamurunnisa, Jayanth Thota, Khalesha Shaik, "Arduino Based Automatic Plant Watering System", International Journal of Advanced Research in Computer Science and Software Engineering, October – 2014
[4]Anurag D, Siuli Roy and Somprakash Bandyopadhyay, "Agro-Sense: Precision Agriculture using Sensor-based Wireless Mesh Networks", ITU-T "Innovation in NGN", Kaleidoscope Conference, Geneva 12-13 May 2008.
[5]Yunseop K. Evans RG, Iversen W M, "Remote sensingand control of an irrigation system using a distributed wireless sensor network"
[6] IEEE Trans. On Instrumentation and Measurement, Vol. 57, pp. 1379- 1387, 2008