Development of a wireless soil moisture sensor

J S Rajashekhar Ekta.Maini Jyoti.Shettar

Abstract: Soil moisture is a vital parameter which decides the crop quality. A prototype model is designed and developed to measure soil moisture and transmit it over long distance for further processing. The model is a combination of sensor, controller and communication module. A 16877A is used as controller. The sensor data is transmitted using Bluetooth transmitter to receiver at base station for logging and display.

Keywords: wireless sensor, soil moisture humidity sensor

J S Rajashekhar Asst.Proffesor
Lecturers DSCE, Bangalore

Ekta.Maini Asst.Proffesor
Lecturers DSCE, Bangalore

Jyoti.Shettar Asst.Proffesor
Lecturers DSCE, Bangalore

INTRODUCTION

Elevated relative humidity at a surface – 70 percent or higher - can lead to problems with mold, corrosion, decay and other moisture related deterioration. When relative humidity reaches 100 percent, condensation can occur on surfaces leading to a whole host of additional problems. ASHRAE Standard 62-2001 Ventilation for Acceptable Indoor Air Quality, recommends that the lower boundary of the relative humidity range be limited to 25 percent and the upper boundary of the relative humidity range be limited to 60 percent. An attempt has been thus made to measure humidity and try to restrict it within the upper and lower limits.

Wireless communication implemented in sensor has applications in a variety of fields such as environmental monitoring, military purposes and gathering, sensing information in inhospitable locations. Connecting sensor, controller and a communication module together is called as a sensor node.

The aim of the project work is to design & develop a sensor node which will monitor the presence of moisture in the soil and analyze the data and then transmit it to a base station for further control action. The node consists of a humidity sensor, Micro controller and a wireless trans-receiver hardware system. Sensor used is a Humidity capacitive sensing probe, which is connected to controller through signal conditioning circuit. The controller used is 16F877A microcontroller because of its low power consumption. It periodically scans the clock and depending upon the time set by the user the sensor data is checked and accordingly process is carried out. Data is transmitted using Bluetooth communication over certain distance. Set point for amount of moisture is taken from user and this set point is compared with process value. As crops are watered only upon requirement, over and under irrigation is avoided which saves power and water resources. The hardware architecture is designed to establish the link between a sensor and a controller. The long-time smooth and proper running of the system in the field proved its high reliability and practicability. As an explorative wireless sensor network in irrigation management, this paper gives a methodology to establish large-scale remote intelligent irrigation system.

I. BLOCK DIAGRAM OF PROPOSED SYSTEM

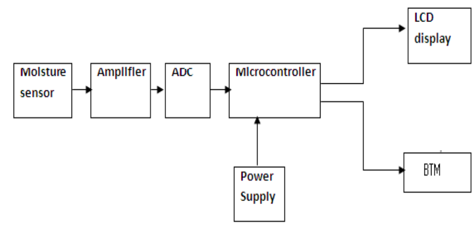

Fig.1.Transmitting section

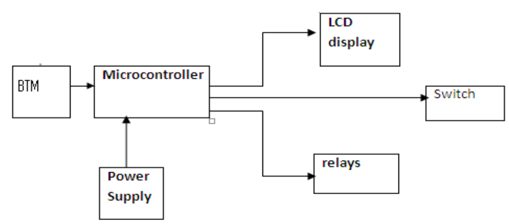

Fig.2. Receiving section

The transmitting section as shown in Fig.3. consists of a Humidity sensor SY-HS220 designed to measure humidity, which is then amplified and sent to analog to digital converter .The digital signal obtained from ADC is given to microcontroller for further processing. This signal is transmitted using Bluetooth module over long distance to a base station. At the receiving station as shown in Fig.4. the signal sent by the transmitter is received through Bluetooth receiver & passed on to the microcontroller. Set point for amount of moisture is taken from user and this set point is compared with process value.

II. DESIGN & IMPLEMENTATION

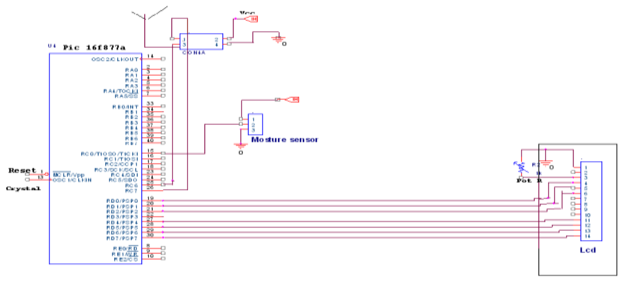

Fig.3. Circuit diagram of transmitting section

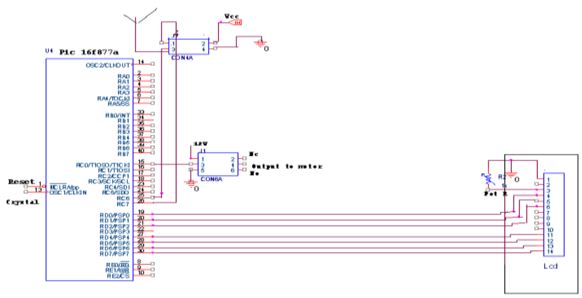

Fig.4. Circuit diagram of receiving section

III. SOFTWARE IMPLEMENTATION

The work emphasizes the development of sensor node for wireless sensor network. It is an embedded system. The MPLAB C Compiler for PIC18 MCUs is a full-featured ANSI compliant C compiler for the PIC18 family of PICmicro® 8-bit MCUs. MPLAB C is a 32-bit Windows console application as well as a fully integrated component of Microchip‟s MPLAB Integrated Development Environment (IDE), allowing source level debugging with MPLAB‟s software and hardware debug engines. Projects, compiler switches and linker customizations can be controlled completely within MPLAB IDE to provide a full graphical front end for this powerful compiler. Text errors in source code and breakpoints instantly switch to corresponding lines in the proper file, and watch windows show data structures with defined data types, including floating point, arrays and structures.

Features:

- ANSI '89 compatibility
- Integration with the MPLAB IDE for easy-to-use project management and source-level debugging
- Generation of relocatable object modules for enhanced code reuse
- Compatibility with object modules generated by the MPASM assembler, allowing complete freedom in mixing assembly and C programming in a single project
- Transparent read/write access to external memory
- Strong support for inline assembly when total control is absolutely necessary

IV. FLOW CHART

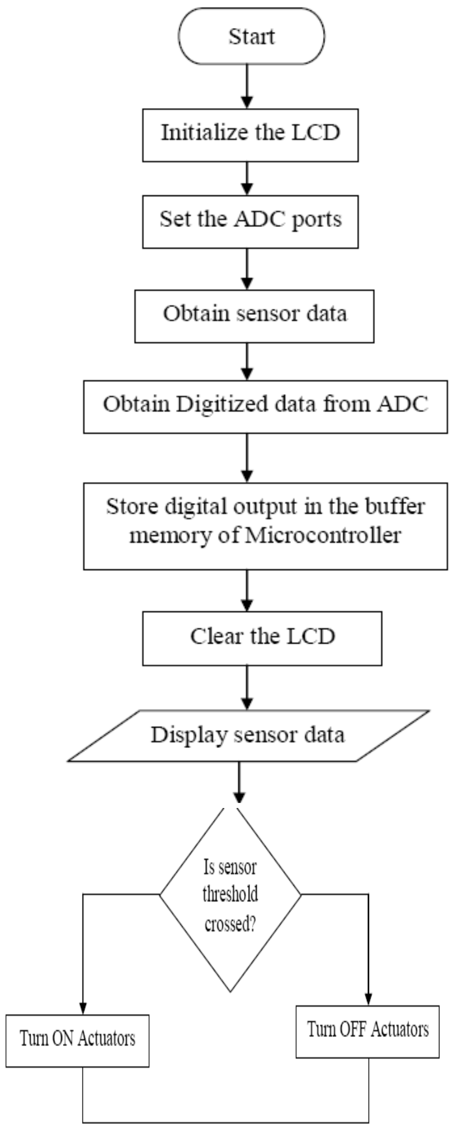

Fig.5. Flow chart

V. RESULTS & DISCUSSION

The data obtained from the hardware module is processed using microcontroller and various parameters are plotted using excel software and the result is compared with the standard.

The Standard data supplied by the manufacturer for the humidity sensor SY-HS-220.

%Relative Humidity	**Spec(mV) SY-HS 220**
30	990
40	1300
50	1650
60	1980
70	2310
80	2640
90	2970

Table 1: Data obtained from manufacturer

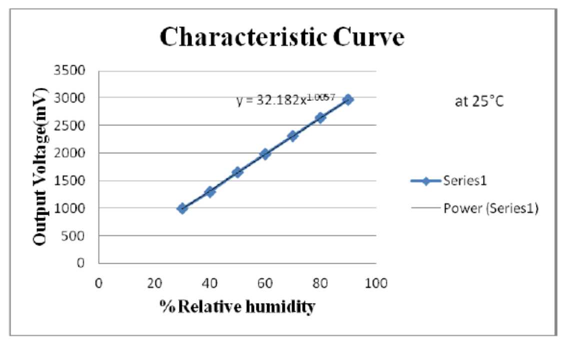

Fig.6. Characteristic graph

The expression obtained from curve fitting is: Output voltage = 32.182 $(\%RH)^{1.0057}$

Using the hardware shown in Fig.3. & Fig.4.and the above expression, the following experiments are conducted and %RH is calculated.

	Output voltage(Volts)	%Relative Humidity
Hot mud	0.29	9
dry	1.25	38
2.5ml water added to mud	3.01	92
Steam	3.23	98

Table 2: %RH & corresponding Output voltage for the Experiments conducted

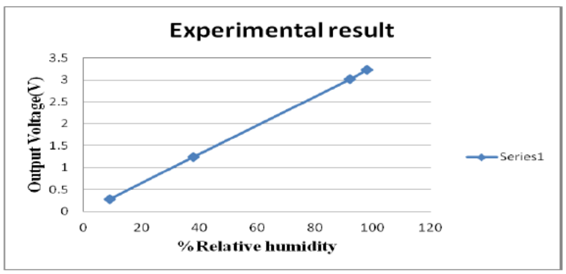

Fig.7. Graph of Output voltage v/s %Relative Humidity

VI. CONCLUSION

Employing embedded technology, based on 16F877A microcontroller, the Wireless Sensor Node was designed and implemented for development of WSN for agricultural applications. Use of smart sensor module causes to enhance the accuracy and reliability as well. On inspection of the results, it is found that the humidity data given by the sensor node is accurate. The humidity data in RH % is continuously observed on the monitor of the base station. Thus, the supervisor could get the humidity of different places of the field which could be helpful to provide controlled environment to the crop to increase the yield. The system works with great reliability. Furthermore, electrical resistivity is calculated for all Relative humidity at different temperature. It is concluded that the least temperature has the highest resistivity and least Relative humidity.

VII. REFERENCES

[1] Kapil Mundada "Development of a Sensor Node to measure Soil Moisture" Department of Instrumentation Engineering, Vishwakarma Institute of Technology, Pune, India

[2] Darold Wobschall, Esensors, Deepak Lakshmanan, "Wireless Soil Moisture Sensor Based on Fringing Capacitance", In Proceeding of the IEEE International Conference on Sensors 2005, Irvine, Orange County, California, USA, Oct 30 -Nov 3, 2005, pp. 8 - 11.

[3] Fedro S. Zazueta and Jiannong Xin2 "Soil Moisture Sensors" university of Florida

[4] F. Kizito a, C.S. Campbell b, G.S. Campbell b, D.R. Cobos b, B.L. Teare b, B. Carter b, J.W. Hopmans "Frequency, electrical conductivity and temperature analysis of a low-cost capacitance soil moisture sensor" Department of Land, Air and Water Resources, University of California, Davis, CA 95616, United States Decagon Devices, Pullman, WA 99163, United States

[5] L. Ruiz-Garcia a,, P. Barreiro a, J.I. Robla" Performance of ZigBee-Based wireless sensor nodes for real-time monitoring of fruit logistics"*

[6] T. A. S. Achala Perera "ZigBee Wireless Soil Moisture Sensor Design for Vineyard Management System" A thesis submitted to Auckland University of Technology in fulfilment of the requirements for the degree of Master of Philosophy (MPhil) May 2010 School of Engineering

[7] "The Aging Correlation (% RH + t): Relative Humidity (%) + Temperature (°C) by E.F Cuddihy, January 15, 1986, Prepared for U.S. Department of Energy through an Agreement with National Aeronautics and Space Administration by Jet Propulsion Laboratory California Institute of Technology Pasadena. California

[8] "Design and Implementation of sensor node for Wireless sensors network to monitor Humidity of High tech polyhouse Environment " B. P. Ladgaonkar and A. M. Pawar Embedded Technology and Instrumentation Laboratory Post Graduate Department of Electronics, Shankarrao Mohite Mahavidyalaya, Akluj Dist. Solapur – 413 101 (M.S.)