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DESIGN AND IMPLEMENTATION OF REAL TIME IRRIGATION SYSTEM USING A WIRELESS SENSOR NETWORK

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ABSTRACT: An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators ,and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The automated system was tested in a sage crop field for 136 days and water savings of up to 90% compared with traditional irrigation practices of the agricultural zone were achieved. Three replicas of the automated system have been used successfully in other places for 18 months. Because of its energy \autonomy and low cost, the system has the potential to be useful in water limited geographically isolated areas.

Keywords: Microcontroller, Gsm/Gprs Modem, Lcd display, Temperature Sensor, Water Level Sensor, Soil Sensor ,Zigbee

INTRODUCTION

Agriculture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements .There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. For instance, in one system plant water status was monitored and irrigation scheduled based on canopy temperature distribution of the plant, which was acquired with thermal imaging .In addition, other systems have been developed to schedule irrigation of crops and optimize water use by means of a crop water stress index (CWSI) [3]. The empirical CWSI was first defined over 30 years ago [4]. This index was later calculated

II. The Hardware System

Micro controller:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI:

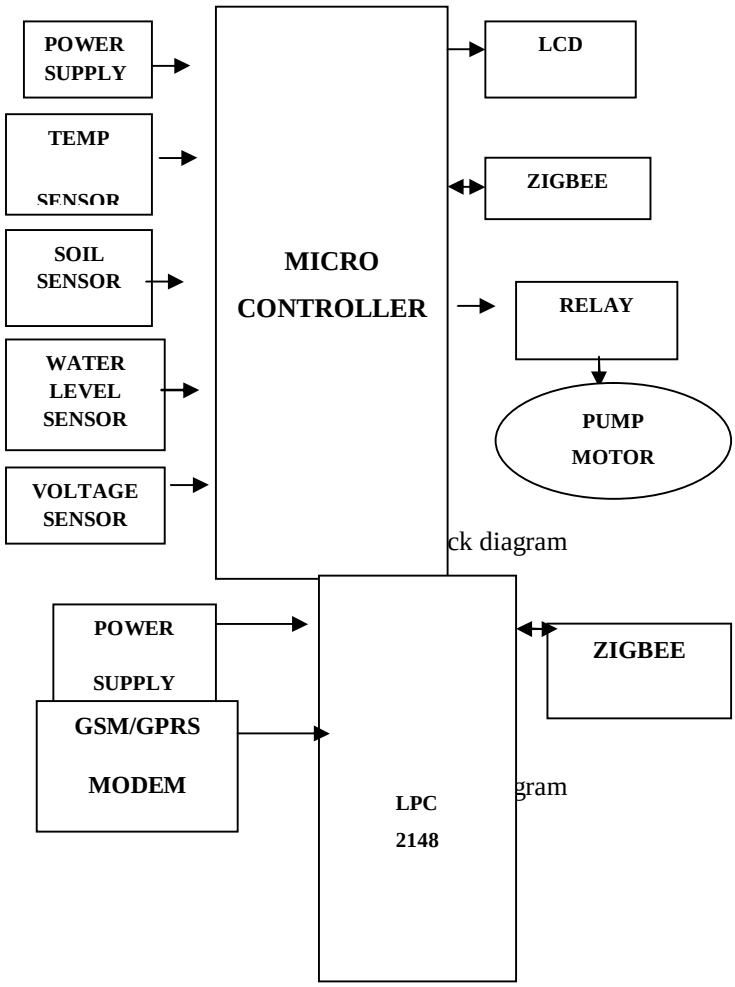
ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that

I. Board Hardware Resources Features

arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

I. Design of Proposed Hardware System



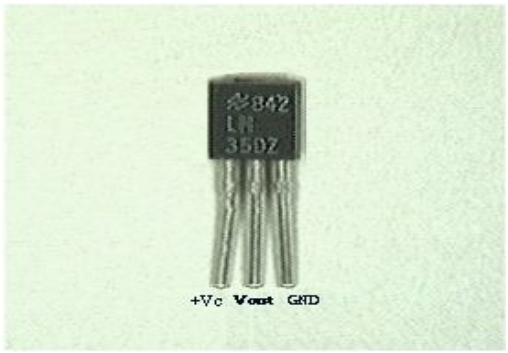
ck diagram

gram

In this paper, the development of the automated irrigation system based on microcontrollers and wireless communication at experimental scale within rural areas is presented. The aim of the implementation was to demonstrate that the automatic irrigation can be used to reduce water use. A microcontroller for data acquisition, and transceiver; the sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture and temperature is reached. Communication between the sensor nodes and the data receiver is via the Zigbee. This receiver unit also has a duplex communication link based on a cellular Internet interface, using General Packet Radio Service (GPRS) protocol, which is a packet oriented mobile data service cellular global system for mobile communications (GSM).

Temperature Sensor:

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C) The LM35 - An Integrated Circuit Temperature Sensor You can measure temperature more accurately than a using a thermistor.The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.



It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/^{o}C The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ^{o}C at room temperature and +/- 0.8 ^{o}C over a range of 0 ^{o}C

to +100 ^{o}C. Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 ^{o}C .

Soil sensor:

The circuit designed uses a 5V supply, fixed resistance of 100Ω, variable resistance of 10KΩ, two copper leads as the sensor probes, 2N222N transistor. It gives a voltage output corresponding to the conductivity of the soil. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil. The voltage output is taken at the transmitter which is connected to a variable resistance. This variable resistance is used to adjust the sensitivity of the sensor

ZigBee

Zigbee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for Low-Rate Wireless Personal Area Networks (LR-WPANs), such as wireless light switches with lamps, electrical meters with

in-home-displays, consumer electronics equipment via short-range radio needing low rates of data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

ZigBee is a low-cost, low-power, wireless mesh networking standard. First, the low cost allows the technology to be widely deployed in wireless control and monitoring applications. Second, the low power-usage allows longer life with smaller batteries. Third, the mesh networking provides high reliability and more extensive range.

Relays: A relay is an electrically controllable switch widely used in industrial controls, automobiles and appliances.The relay allows the isolation of two separate sections of a system with two different voltage sources i.e., a small amount of voltage/current on one side can handle a large amount of voltage/current on the other side but there is no chance that these two voltages mix up.

I. CONCLUSION

The automated irrigation system implemented was found to be feasible and cost effective for optimizing water resource for agricultural production.

This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. The automated irrigation system developed proves that the use of water can be diminished for a given amount of fresh biomass production. The use of solar power in this irrigation system is pertinent and significantly important for organic crops and other agricultural products that are geographically nisolated, where the investment in electric power supply would be expensive. The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance. The modular configuration of the automated irrigation system allows it to be scaled up for larger greenhouses or open fields. In addition, other applications such as temperature monitoring in compost production can be easily implemented. The Internet controlled duplex communication system provides a powerful decision making device concept for adaptation to several cultivation scenarios. Furthermore, the Internet link allows the supervision through mobile telecommunication devices, such as a smart phone. Besides the monetary savings in water use, the importance of the preservation of this natural resource justify the use of this kind of irrigation systems.

III. REFERENCES

[1] W. A. Jury and H. J. Vaux, “The emerging global water crisis: Managingscarcity and conflict between water users,” Adv. Agronomy, vol. 95, pp. 1–76, Sep. 2007.

[2] X. Wang, W. Yang, A. Wheaton, N. Cooley, and B. Moran, “Efficient registration of optical and IR images for automatic plant water stressassessment,”Comput. Electron. Agricult., vol. 74, no. 2, pp. 230–237,Nov. 2010.

[3] G. Yuan, Y. Luo, X. Sun, and D. Tang, “Evaluation of a crop waterstress index for detecting water stress in winter wheat in the North China Plain,”Agricult. Water Manag., vol. 64, no. 1, pp. 29–40, Jan. 2004.

[4] S. B. Idso, R. D. Jackson, P. J. Pinter, Jr., R. J. Reginato, andJ. L. Hatfield, “Normalizing thestressdegreedayparameterforenvironmentalvariability,”Agricult. Meteorol., vol. 24, pp. 45–55, Jan. 1981.

[5]Y.Erdem,L.Arin,T.Erdem,S.Polat,M.Deveci,H.Okursoy,andH. T. Gültas, “Crop water stress index for assessing irrigation schedulingof drip irrigated broccoli (Brassica oleracea L. var. italica),”Agricult. Water Manag., vol. 98, no. 1, pp. 148–156, Dec. 2010.

[6] K. S. Nemali and M. W. Van Iersel, Anautomated system for controlling drought stress and irrigation in potted plants," Sci. Horticult.,vol. 110, no. 3, pp. 292–297, Nov. 2006.

[7] S. A. O'Shaughnessy and S. R. Evett, "Canopy temperature based system effectively schedules and controls center pivot irrigation of cotton,"Agricult. Water Manag., vol. 97, no. 9, pp. 1310–1316, Apr. 2010.

[8] R. G. Allen, L. S. Pereira, D. Raes, and M. Smith, CropEvapotranspiration-Guidelines for Computing Crop WaterRequirements—FAO Irrigation and Drainage Paper 56. Rome, Italy:FAO, 1998.

[9] S. L. Davis and M. D. Dukes, "Irrigation scheduling performance,"Agricult. Water Manag., vol. 98,no. 1, pp. 19–28, Dec. 2010.

[10] K. W. Migliaccio, B. Schaffer, J. H. Crane, and F. S. Davies, "Plantresponse to evapotranspiration and soil water sensor irrigation scheduling methods for papaya production in south Florida," Agricult. WaterManag., vol. 97, no. 10, pp. 1452–1460, Oct. 2010.

[11] J. M. Blonquist, Jr., S. B. Jones, and D. A. Robinson, "Precise irrigationscheduling for turfgrass using a subsurface electromagnetic soil moisture sensor," Agricult. Water Manag., vol. 84, nos. 1–2, pp. 153–165,Jul. 2006.

[12] O. M. Grant, M. J. Davies, H. Longbottom, and C. J. Atkinson,"Irrigation scheduling and irrigation systems: Optimising irrigation efficiency forcontainer ornamental shrubs,"Irrigation Sci., vol. 27, no. 2, pp. 139–153, Jan. 2009.

[13] Y. Kim, R. G. Evans, and W. M. Iversen, "Remote sensing and control of nan irrigation system using a distributed wireless sensor network,"IEEE Trans. Instrum. Meas., vol. 57, no. 7, pp. 1379–1387, Jul. 2008.

[14] Y. Kim and R. G. Evans, "Software design for wireless sensor-basedsite-specific irrigation," Comput. Electron. Agricult., vol. 66, no. 2,pp. 159–165, May 2009.

[15] D. K. Fisher and H. A. Kebede, "A low-cost microcontroller-basedsystem to monitor crop temperature and water status,"Comput. Electron.Agricult., vol. 74, no. 1, pp. 168–173, Oct. 2010.

[16] Y. Kim, J. D. Jabro, and R. G. Evans, "Wireless lysimeters for realtime online soil water monitoring," Irrigation Sci., vol. 29, no. 5, pp. 423–430, Sep. 2011.

[17] O. Mirabella and M. Brischetto, "A hybrid wired/wireless networkinginfrastructure for greenhouse management," IEEE Trans. Instrum. Meas.,vol. 60, no. 2, pp. 398–407, Feb. 2011.

[18] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "A surveyon sensor networks,"IEEE Commun. Mag., vol. 40, no. 8, pp. 104–112, Aug. 2002.

[19] J. Yick, B. Mukherjee, and D. Ghosal, "Wireless sensor network survey,"Comput. Netw., vol. 52, no. 12, pp. 2292–2330, Aug. 2008.

[20] M. Winkler, K.-D. Tuchs, K. Hughes, and G. Barclay, "Theoretical andpractical aspects of military wireless sensor networks,"J. Telecommun. Inf. Technol., vol. 2, pp. 37–45, Apr./Jun. 2008.

[21] M. P. Durisic, Z. Tafa, G. Dimic, and V. Milutinovic, "A survey ofmilitary applications of wireless sensor networks," inProc. MECO,Jun. 2012, pp. 196–199.

[22] M. C. Rodríguez-Sánchez, S. Borromeo, and J. A. Hernández-Tamames,"Wireless sensor networks for conservation and monitoring culturalassets,"IEEE Sensors J., vol. 11, no. 6, pp. 1382–1389, Jun. 2011.

[23] G. López, V. Custodio, and J. I. Moreno, "LOBIN: E-textile andwireless-sensor-network-based platform for healthcare monitoring infuture hospital environments," IEEE Trans. Inf. Technol. Biomed.,vol. 14, no. 6, pp. 1446–1458, Nov. 2010.
[24] J. M. Corchado, J. Bajo, D. I. Tapia, and A. Abraham, "Usingheterogeneous wireless sensor networks in a telemonitoring system for healthcare," IEEE Trans. Inf. Technol. Biomed., vol. 14, no. 2,pp. 234–240, Mar. 2010.
[25] G. X. Lee, K. S. Low, and T. Taher, "Unrestrained measurement of arm motion based on a wearable wireless sensor network,"IEEE Trans. Instrum. Meas., vol. 59, no. 5, pp. 1309–1317, May 2010.

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