Wireless Network Sensors for Precise Agriculture Monitoring

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Abstract—**An Automated irrigation system got greater, stronger, more complete to optimize water use of farming the years produce. The system has a made distribution radio Network of soil-moisture, soil-temperature, humidity and ph sensors placed in the root band of plants. In addition , a way in unit handles sensor information, puts into motion actuators and gives on data to personal computer. An algorithm was undergone growth with threshold values of temperature, moisture, humidity, PH that was programmed into microcontroller-based way in to control water amount and also control the Motor. Papers describe an application of a WSN for low-cost wireless controlled and monitored irrigation result. The developed irrigation scheme remove the need for workmanship for flood irrigation. Resourceful water management acting an important role in the irrigated agricultural cropping systems .System was power-driven by photovoltaic panels and had a duplex communication link based on cellular –internet connection that let for data check out and watering system listing details to be programmed through personal computer. The implementation of WSN in PA will optimize the usage of water fertilizer and also maximized yield of crops.**

Keywords – Wireless Sensor Network (WSN), Sensors, Precision Agriculture (PA).

I.INTRODUCTION

AGRICULTURE use 85% of existing freshwater assets worldwide, and this percentage will carry on to be leading in water spending because of population growth and improved food demand. There is an critical need to produce strategies base on science and technology for sustainable utilize of water, include technical, agronomic, managerial, an institutional improvements [1]. There area unit millions of systems to accomplish water savings in several crops, from basic ones to additional technologically higher ones. For example, in single system crop or plant water position was monitored and irrigation scheduled based on canopy temperature sharing of the crop or plant, which was acquired with thermal imaging [2].In adding, 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 primary definite over 30 years ago [4]. This index was later designed using dimensions of infrared canopy temperatures, ambient air temperatures, and atmospheric vapour pressure deficit values to decide when to irrigate broccoli using drip irrigation [5].Irrigation systems can also be automated all through information on volumetric water substance of soil, using dielectric moisture sensors to manage actuators and save water, as a substitute of a programmed irrigation schedule at a challenging time of the day and with a detailed period. An irrigation controller is used to open a solenoid valve and apply watering to bedding plants when the volumetric water substance of the substrate drops under a set point .

II.WIRELESS SENSOR NETWORK

A WSN is a spread sensor network to observe physical or environmental situations, such as temperature, humidity and moisture to cooperatively exceed their data through the network to a main location. These networks are bi-directional and also allow manage of sensor action. The WSN is construct of node s which consists of a few to several hundreds or yet thousands, where every node is related to one or several sensors. Fig. 1 shows a general WSN node architecture. Every sensor network node consists of a sensor module, processor module, communication module and power module using battery.

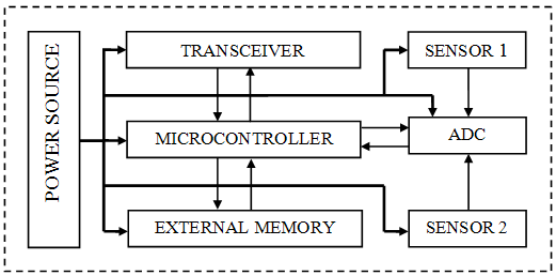

Fig 1 - WSN Node Architecture

A WSN for agriculture is similar to those used in other industries such as industrial manage, building computerization and protection systems. The WSN system for PA requires a federal control unit with user interface, communication gateways and routers, control elements and most significantly are the sensors.

Unlike other systems, PA requires a exclusive software model for each environmental area, the essential soil type and the particular crop or plants. For example, each position will receive its own optimum amount of water, fertilizer and pesticide.

IV.SYSTEM ARCHITECTURE

The automated irrigation system here by reported, consisted of two components transmitter and receiver(Fig.1 and Fig.2),linked by radio transceivers that allowed the transfer of soil moisture and temperature data, implement a WSN that uses RF technology. Arrangement of the automated irrigation system, transmitter and a receiver depend on microcontroller RF technologies.

The information can be slightly monitored through a PC.

A. TRANSMITTER SIDE:

A Transmitter is comprised of a RF transceiver, sensors, a microcontroller, and power sources. A number of Transmitters can be deployed in-field to arrange a circulated sensor network for the automated irrigation system. Every unit is based on the microcontroller PIC16FJ88 Technologies, that control the radio modem RF module and processes information from the soil-moisture sensor and the temperature sensor. These components are powered by rechargeable AA 2000-mAh Ni-MH Cycle Energy batteries The charge is maintained by a photovoltaic panel to achieve full energy autonomy. These components were selected to minimize the power consumption for the proposed application.

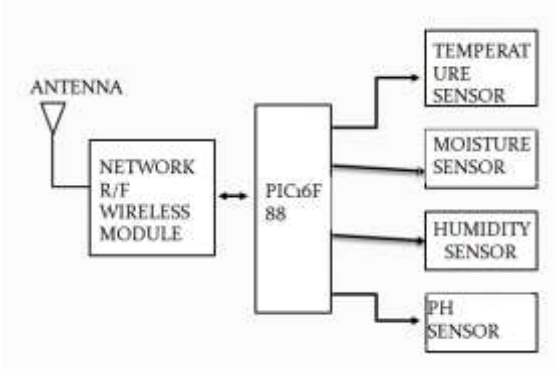

Fig 2- block diagram of transmitter

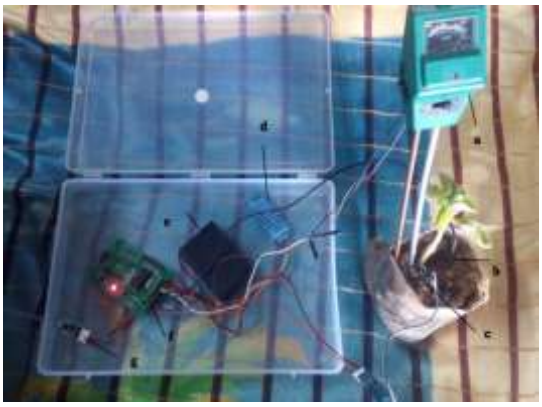

Fig 3- Transmitter section.(a.PH sensor, b. Soil-temperature sensor, c. Soil-moisture sensor , d. Humidity sensor , e. Batteries , f. PIC16F88 microcontroller , g. RF module).

Single-Chip PIC16F88: A 16-bit microcontroller with 18-pins and nW XLP technology that operate in a range 2.0 to 3.6 V at 8 MHz with inner oscillator. The microcontroller was programmed in C compiler 4.12 (Custom Computer Services, Waukesha, WI) with the appropriate algorithm for monitoring the soil-moisture probe through an analog-to-digital port and the soil-temperature probe through another digital port, implemented in 1-Wire communication protocol. A battery voltage monitor is included through a high-impedance voltage divider coupled to an analog-to-digital port. The data are packed with the corresponding identifier, date, and time to be transmitted via RF radio modem using a RS-232 protocol through two digital ports configured as TX and receiver RX, respectively. After sending data, the microcontroller is set in sleep mode for certain period according to the sensor sampling rate desired, whereas the internal RTCC is running. This operation mode allows energy savings. When the TRANSMITTER is launched for first time, the algorithm also inquires the RECEIVER.

B.RECEIVER SIDE

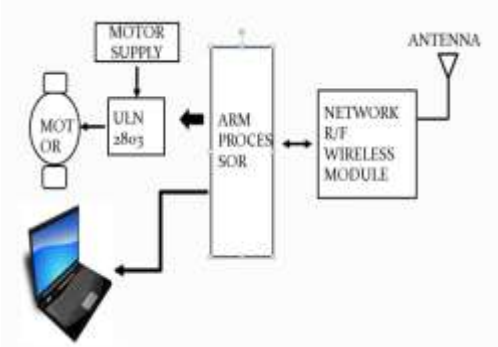

Fig :- Block diagram of receiver

Fig :- Receiver section(A. Motor connections, B. Arm processor, C. Diplay , D. RF module)

1) ARM PROCESSOR:

It is a ARM-7 based micro controller . **ARM7** is one of the broadly used micro controller in embedded system application. This section unassuming effort for explaining basic features of **ARM-7.**

ARM is a family of instruction set architectures for computer processors based on RISC architecture developed by British company **ARM Holdings**.

A RISC based computer design approach means ARM processors need significant smaller amount transistors than usual processors in average computers . This approach reduces price, heat and power use. These are desirable character for light , portable, battery powered devices-including smart phones, laptops, tablets and notepad computers and other embedded systems. A simple design facilitates more efficient multi core CPUs and higher core counts at low cost , providing higher processing power and improved energy efficiency for servers and super computers.

The pin diagram of LPC2148 is shown in below fig.

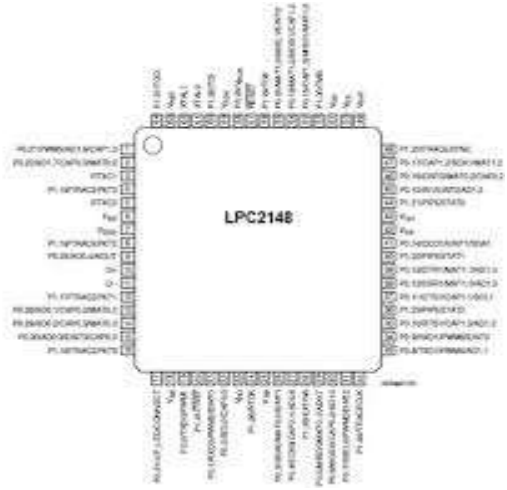

Fig 4: pin diagram of LPC2148

III.SOIL MOISTUR, TEMPERATURE, HUMIDITY SENSORS.

Soil-moisture sensor - One of the most significant parameter for PA field measurement is soil moisture. Soil moisture is the water that is believed in the spaces between soil particles. Soil moisture is the key factor to determine when to irrigate and amount of water to supply. Based on observation, most of the time, the fields are over irrigated. Over irrigation prevent the nitrogen to be used by roots, and lack of oxygen in the root area. Different crops want different level of moisture to maximize the production.

Soil and neighbouring atmosphere temperature play an significant role in irrigation. In normal conditions, the temperature near the plant is less due to vanishing process.

There is a large body of literature describing soil moisture dimension methods. Currently there are two main category of soil moisture measurements: contact- based and contact-free methods. Contact-based methods require direct contact with the soil. Examples of contact methods contain capacitance sensors, heat pulse sensors, fibre optic sensors .

The second category consists of contact free measurement techniques. Remote sensing methods are well-known in this category. Remote sensing methods consist of passive microwave radiometers, synthetic aperture radars , and thermal methods .

These methods are either ground based or operated from airborne or space borne platforms. Limitations of present remote sensing methods are problems with spatial averaging and a small diffusion depth. These limitations create it difficult to obtain accurate values of soil moisture at a much smaller spatial support than the assessment, and to sense moisture variation away from a thin surface layer.

The circuit diagram of the soil moisture sensor is shown below

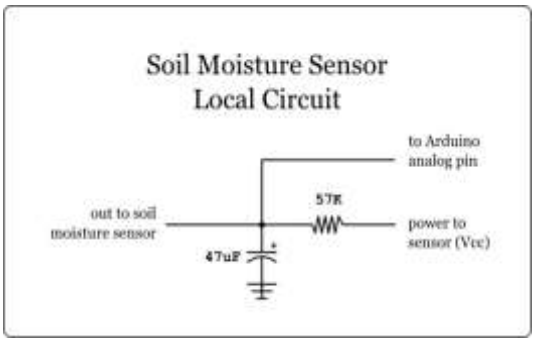

Fig 5:block diagram of Soil Moisture Sensor

*Humidity sensor***:** Humidity is the existence of water in air. The amount of water vapour in air can act on manlike comfort as well as many making processes in industries. The existence of water vapour also effects physical, chemical, and biological processes. Humidity measurement in industries is full danger because it may act on the business price of the product and the health and safety of the body of working persons. For this reason humidity sensing is very important , especially in the control systems for to do with industry processes and man like comfort.

The diagram of humidity sensor is shown below

Fig 6 : Humidity sensor

In harmony with to the measurement units, humidity sensors are separated into two sorts: in comparison with humidity sensors and complete humidity sensors. Most humidity sensors are in comparison with humidity sensors and use different sensing sense of right. Humidity measurement can done using dry and wet bulb hygrometers, water drops from night air point hygrometers, and electronic hygrometers. There has been a surge in the request of electronic hygrometers, often telephoned humidity sensors . Electronic letters used for printing hygrometers or humidity sensors can be widely separated into two groups: one employs capacitive sensing sense , while other use resistive effects.

Soil Temperature sensor **:**

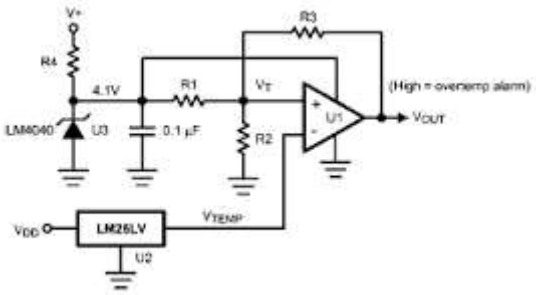

Fig 7: Soil temperature sensor

V. PIC16F88 MICRO CONTROLLER

PIC is a family of modified Harvard architecture. Microcontrollers equipped by microchip technology imitative from the PIC1650 in the beginning developed by General instrument's microelectronics classification. The call PIC primarily in use to "Peripheral Interface Controller"' now it is "PIC"' only. PICs are popular with both industrial developers and hobbyists alike due to their low value, wide avail facility, large consume base, extensive gathering of application notes, avail facility of low value or free development tools, and serial programming (and reprogramming with flash memory) cap service.

Performance**:** The architectural ruling is focussed at the maximization of speed-to-value ratio. The PIC architecture was among the primary scalar CPU designs and is still among the simplest and economical. An replica of this is a video sync pulse generator. This is no longer exact in the innovativeness PIC models; because they have a sync interrupt latency of 3 or 4 cycles.

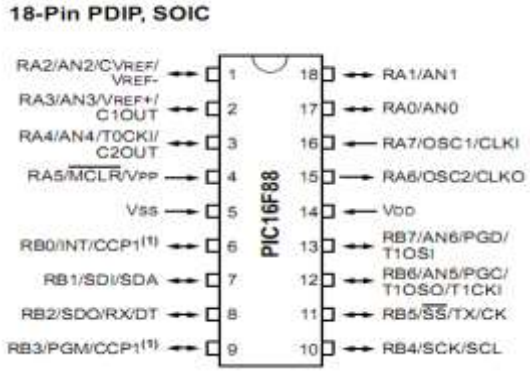

Fig 8 : PIN Diagram of PIC16F8

Advantages:

1. Simple to learn because of little instruction set
2. RISC architecture
3. Oscillators are in build with selectable speeds
4. Entry level is very simple, in-circuit programming plus in circuit debugging PIC
5. Microcontrollers are luxuriously very high
6. Broad range of interfaces it include I²C, SPI, USB, USART, A/D and comparators are programmed, PWM, LIN, CAN, PSP, and Ethernet
7. Simple to handle for hobby operate due to Avail facility of processors in DIL package

V.SYSTEM OPERATION

The major aim of this work is to save the water, electricity and develop the growth of plant. Consider farmer's cost-effective conditions we have prepared a circuit which is cheap and reliable Soil moisture, Soil temperature and Humidity sensing networks are used to monitor the moisture, temperature and humidity controlled in soil. According to that advance action is taken by microcontroller as the output of network is given to the microcontroller. Indicators indicate whether the soil is dry or wet, whether temperature high or low and humidity low or high . Microcontroller is the key part of the system; it control the total irrigation system. It takes the input from moisture, temperature , humidity sensors and according to the printed program it turns START or STOP the motor pump. It also indicate the state of soil. Also it provide the data to the PC through RF module. When soil is dry and temperature high motor is on and when soil is wet and temperature is low motor is STOP. Thus microcontroller handles the working of motor. RF module is a communication technology like a Bluetooth but different that it is a FDC(full duplex communication). It is used here to have wireless link connecting PC & the most important irrigation system. So that data can be logged into PC. AC or DC motor can be used for whole system. On the basis of soil moisture , temperature , humidity detection , motor ON/OFF working will be completed. Condition of water and consider the require of water to the plants or crops is done by controlling motor. Along with this the values are made on depending on the state of the soil. LCD is also used at field .It indicates message from the microcontroller soil state, motor state.

Fig9:- Data window

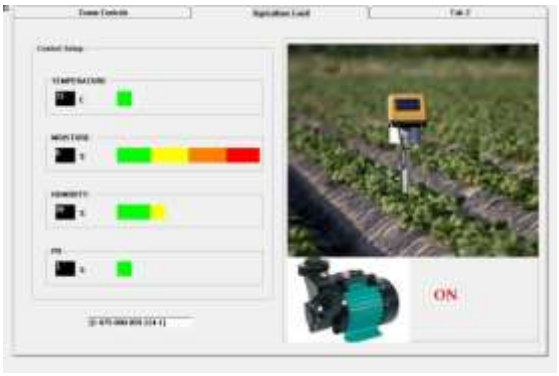

Fig 10 :- The values of sensors below the threshold values motor is START or ON

TABLE1. COMPONENTS FOR TRANSMITTER SIDE

Description	*Part number*
Microcontroller	PIC16F88
Transceiver	RF module
Soil moister sensor	
Soil temperature sensor	
Humidity sensor	AMT1008
PH sensor	
Batteries	AA 2000 mAh Ni-MH
Miscellaneous(voltage regulators, connectors, capacitors, resistors, etc)	

TABLE2:COMPONENTS FOR RECEIVER SIDE

Description	*Part number*
Microcontroller	LPC2048
Transceiver	RF module
Relay	ULN 2803
Personal computer	
Miscellaneous(voltage regulators, connectors, capacitors, resistors, etc)	

VI.CONCLUSION

Precision agriculture is a comprehensive system designed to optimize agriculture production. Using the key elements of information, technology, and management, precision agriculture can be used to increase production efficiency, improve product quality, improve the efficiency of crop chemical use, conserve energy, and protect the environment. In a greenhouse environment using WSN, our test shows clearly that automatic irrigation is more efficient compared to scheduled irrigation. Automatic irrigation will optimize the usage of water and fertilizer and furthermore maintain the moisture level and healthiness of the plant.

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