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# Zigbee based wireless Sensor Network for Monitoring an Agricultural Environment

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## Abstract

***This paper presents the design and the implementation of a Wireless Sensor Network that can monitor the air temperature, humidity and ambient light intensity in a crop field. This can help the end users such as farmers in the better understanding of agriculture practices to be adopted for crop management. Since, early detection of plant fires is necessary to prevent high crop damages; a plant fire detection scheme has also been incorporated in the system. The system consists of nodes, which are equipped with small size application specific sensors. The sensor data is transmitted via zigbee transreciever to the centrally localized computer terminal for data logging and analysis.. The sensor nodes can additionally be programmed from the computer terminal itself according to the changing needs of farmers, thus preventing the need for a redeployment of the Wireless Sensor Network every time some changes are to be made.***

***Keywords: Zigbee, System architecture, Sensor network, ARM processor, Wireless communication, IR sensor.***

## I.INTRODUCTION

Efficient water management is a major concern in many cropping systems in semiarid and arid areas. Distributed in-field sensor-based irrigation systems offer a potential solution to support site-specific irrigation management that allows producers to maximize their productivity while saving water. This paper describes details of the design and instrumentation of variable rate irrigation, a wireless sensor network, and software for real-time in-field sensing and control of a site-specific precision linear-move irrigation system. Field conditions were site-specifically monitored by six in-field sensor stations distributed across the field based on a soil property map, and periodically sampled and wirelessly transmitted to a base station. An irrigation machine was converted to be electronically controlled by a programming logic controller and wirelessly communicates with a computer at the base station. Communication signals from the sensor network and irrigation controller to the base station were successfully interfaced using low-cost ZigBee wireless radio communication. Graphic user interface-based software developed in this paper offered stable remote access to field conditions and real-time control and monitoring of the variable-rate irrigation controller.

The development, testing, and use of an integrated distributed wireless sensor network (WSN) that utilizes ZigBee technology are presented in this paper for sensor-based variable rate irrigation systems. The WSN maintenance costs. The WSN uses an *ZigBee* network, i.e., a mobile wireless network. Compared with a wireless local area network (WLAN), *ZigBee networks* have advantages for agricultural applications, because the mobility and self configuration are more suitable for a distributed sensor network in fields. The objective of this paper is to report the design, construction, and testing of a distributed in-field WSN, a remote sprinkler head valve control, and user-friendly software for real time in-field sensing and control of a variable rate irrigation system.

## II.SYSTEM ARCHITECTURE

The System Architecture has two sections. They are

1. Crop field Section
2. Monitoring Section

## 1. Crop Field Section:

Figure1 shows the paddy crop field section.paddy crop field section consist of sensors with ARM processor, temperature sensor is used to find the temperature of atmosphere, Humidity sensor is used to find moisture of soil, ph sensor is used to find the level of the water and IR sensor is used to detect when ever any object occur and those information will send to field crop monitoring section using Zigbee module, it is protocol it is work based request and acknowledge.

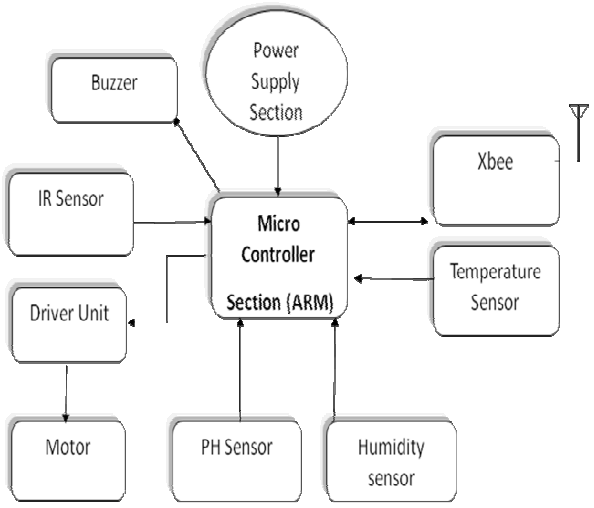


Figure1: Paddy Crop field section

## 2. Monitoring Section:

Fig. 2 represents the crop field monitoring section. Here paddy crop field data from section is received by Zigbee receiver in crop field monitoring section. Here system program will checks the crop field information and stores in the database. By using the values we can monitor the agriculture environment.

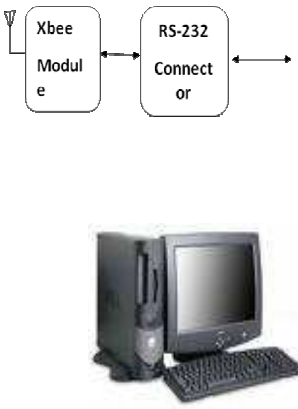


Figure2: Crop field monitoring section

## 3. ARM Processor:

ARM7 Processor as shown in Figure.3. The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7TDMI core uses a three-stage pipeline to increase the flow of instructions to the processor. This allows multiple simultaneous operations to take place and continuous operation of the processing and memory systems.

(1) Operating modes: The ARM7TDMI core has seven modes of operation

- User mode is the usual program execution state
- Interrupt (IRQ) mode is used for general purpose interrupt handling
- Supervisor mode is a protected mode for the operating system
- Abort mode is entered after a data or instruction pre fetch abort
- System mode is a privileged user mode for the operating system
- Undefined mode is entered when an undefined instruction is executed.

The interrupt settings of ARM support the DHLS to response to the interrupt coming from the server section.

(2) Interrupt controller: The Vectored Interrupt Controller (VIC) accepts all of the interrupt request inputs from the home server section and categorizes them as Fast Interrupt Request (FIQ), vectored Interrupt Request (IRQ), and non-vectored IRQ as defined by programmable settings. So ASRS system can able to separate the command signals and easily will select the speed in the vehicle.

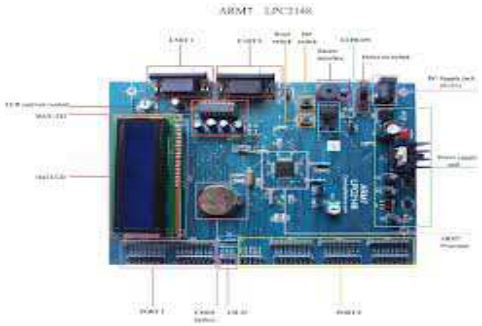

Figure3: ARM Processor

## III.SENSOR NETWORK

A **wireless sensor network (WSN)** consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

In this agriculture environment monitoring system we are using two sensors

1. Temperature Sensor
2. Humidity sensor
3. IR sensor
4. PH sensor

### 1. Temperature Sensor:

The figure4 shows the temperature sensor. LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It c4.an be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package.

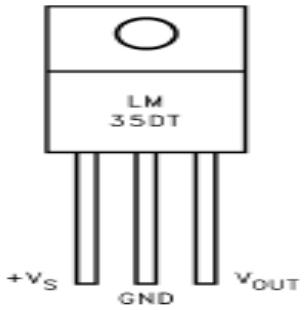


**Figure4: Temperature Sensor.**

### 2. Humidity sensor:

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human Comfort.

**Figure5: Humidity Sensor**

### 3. IR sensor

Infrared (IR) radiation is electromagnetic radiation of a wavelength longer than that of visible light, but shorter than that of microwaves. The name means "below red" (from the Latin infra, "below"), red being the color of visible light with the longest wavelength. Infrared radiation has wavelengths between about 750 nm and 1

mm, spanning five orders of magnitude. Humans at normal body temperature can radiate at a wavelength of 10 microns.

Transmitter: a blinking IR light

Receiver: a light dependent resistor

infrared digital communication

- must have line- of-sight
- direction dependent
- short distances
- reflection
- can suffer from sunlight and tube light (TL) noise

## IV.WIRELESS COMMUNICATION

### Zigbee:


**Figure 6: Module of zig bee**

Zig-bee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4,2006 standard for wireless personal area networks (WPANs),such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the Zig-bee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. Zig-bee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

Zig-bee is a low data rate, two-way standard for home automation and data networks. The standard specification for up to 254 nodes including one master, managed from a single remote control. Real usage examples of Zig-bee includes home automation tasks such as turning lights on, setting the home security system, or starting the VCR. With Zig-bee all these tasks can be done from anywhere in the home at the touch of a button. Zig-bee also allows for dial-in access via the Internet for automation control.

Zig-bee protocol is optimized for very long battery life measured in months to years from inexpensive, off-the-shelf non-rechargeable batteries, and can control lighting, air conditioning and heating, smoke and fire alarms, and other security devices. The standard supports 2.4 GHz (worldwide), 868 MHz (Europe) and 915 MHz (Americas) unlicensed radio bands with range up to 100 meters.

## V. CONCLUSION

In this system we are doing advance monitoring & controlling of an agriculture area and giving security system. For detecting the objects we kept IR should detect buzzer will turn on. Temperature, humidity, ph level values will be monitored in VB.

In this demonstration when any value exceed motor will run. This is very useful for agriculture peoples. By using this technique they can monitor and control the agriculture area from anywhere.

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## Biography

**B.Vinay Kumar** was born in Warangal district, A.P, India. He received B-Tech in Electronics and Communication Engineering from Ramappa Engneering College, Warangal (dist), A.P, India. Pursuing M. Tech in Embedded Systems at SR Engineering College, Warangal, A.P, India.

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