# WSN Design Model for Irrigation Management System

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**Abstract:**

*Automatic irrigation systems are convenient, especially for those who travel. If installed and programmed properly, automatic irrigation systems can even save your money and help in water conservation. Dead lawn grass and plants need to be replaced, and that can be expensive but the savings from automatic irrigation systems can go beyond that. The proposed irrigation controller node is composed of a micro-processor, transceivers, analog to digital converters.The sensing parameters can be displayed as values in PC. If there are any exceed condition of parameters (Temperature, Fire, Humidity, Moisture) ,then alert will be made.This system makes remote monitoring possible in irrigation applications.*

***Key words:*** **ARM,Wi-Fi ,sensors, ADC**

## I. INTRODUCTION

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.

An alternative parameter to determine crop irrigation needs is estimating plant evapotranspiration (ET). ET is affected by weather parameters, including solar radiation, temperature, relative wind speed, and crop factors, such as stage of growth, variety and plant density, management elements, soil properties, pest, and disease control [8]. Systems based on ET have been developed

that allow water savings of up to 42% on time-based irrigation schedule. Automatic irrigation systems are convenient, especially for those who travel. If installed and programmed properly, automatic irrigation systems can even save your money and help in water conservation. Dead lawn grass and plants need to be replaced, and that can be expensive but the savings from automatic irrigation systems can go beyond that. Watering with a hose or with oscillator wastes water. !either method targets plant roots with any significant degree of precision.

Automatic irrigationsystems can be programmed t o discharge more precise amounts of water in a targeted area, which promotes water conservation since the deployment and use of wired systems in remote areas is usually unfeasible due to high costs, wireless is the best solution. The irrigation controller node is composed of a micro-processor, transceivers, analog to digital converters. Sensor nodes are deployed for field process monitoring and control. The sensing parameters can be displayed as values in PC with alert conditions in case of any extreme level. This system makes remote monitoring very reliable in remote cases.
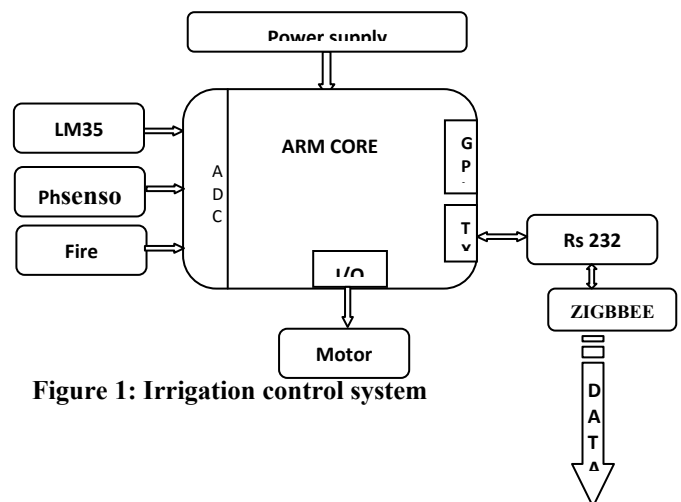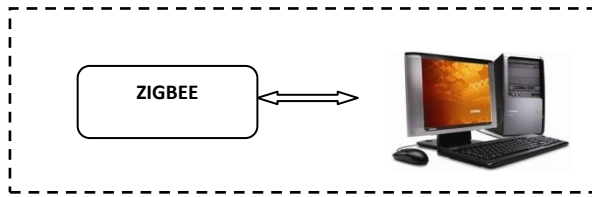
**Block Diagram:**



**Figure 1: Irrigation control system**

**International Journal of Research**

Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

**Fig2: Server unit**

## II. Design and Implementation

The irrigation controller node is composed of a micro-processor, transceivers, analog to digital converters. Sensor nodes are deployed for field process monitoring and control. Temperature sensor is an electronic device which provides a voltage analogue of the temperature of the surface on which it is mounted. This voltage will be passed to the ARM processor ADC channel 0. Then the ADC converter will give a digital sensor value which will be transferred through the UART protocol and then reaches the server through ZigBee communication.

In order to find the moisture level in the irrigation field we uses the Ph sensor. In this proposed work, we are using a Resistive type Ph sensor which pick up changes in the resistance value of the sensor element in response to the change in the Ph. Then a polymeric film is applied on the electrode; the film acts as a Ph sensing film due to the existence of movable ions. Change in impedance occurs due to the change in the number of movable ions.This change in movable ions causes change in the resistive metal which in turn creates voltage change in the sensor. This will be a very minute voltage change.

IN order to read the voltage change, a comparator LM358 is used in the sensor board. The comparator continuously checks the sensor voltage with the reference voltage. If the sensor voltage exceeds the reference voltage then the comparator gives digital logic output ( high or low). An led indication will be given in the kit for user identification. This voltage will be given to the microcontroller for further transmission and motor will be controlled based on the result. Irrigation field may get fire accident at any time. So we use the fire sensor of

thermistortype, which is efficient, inexpensive, easily-obtainable temperature sensing material. When the external heat is applied to the thermistor, it will generate voltage in the circuit. The output voltage from the thermistor is given to the comparator for voltage amplification. This in turn helps in detecting a very small voltage changes which in turn detects all range heat variation. The sensor contains led lights as indicators. If the temperature level exceeds the reference set point then, led lights will give indication. All the values will be displayed in the PC , then for any threshold value crossing , an interrupt will be passed to the kit through wireless communication, which alerts the spots.

## III. System Hardware

### 1.ARM-LPC2926/2927/2929

TheLPC2148combineanARM768E- SCPU core with two integrated TCM blocks operating at frequencies of up to 125 MHz, Full-speed USB2.0OTGand device controller, CAN and LIN, 56kB SRAM, upto768kBflashmemory, external memory interface, three10-bitADCs,and multiple serial and parallel interfaces in a single chip targeted at consumer, industrial and communication markets. To system power consumption, the LPC2926/2927/2929hasavery flexible Clock Generation Unit(CGU) that provides dynamic clock gating and scaling.

TheARM768E-Sisa general purpose 32-bit RISC processor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer(RISC) principles, and the instruction set and related decode mechanism are much simple than those of micro programmed Complex Instruction Set Computers(CISC).This simplicity result high instruction throughput and impressive real-time interrupt response from a small and cost-effective controller core.

AmongstthemostcompellingfeaturesoftheARM768E-Sare:

•Separatedirectly connectedinstruction anddata TightlyCoupledMemory(TCM)interfaces

•WritebuffersfortheAHBandTCMbuses

**Figure 1. ARM Processor**

Pipeline techniques are employed so that all part sof the processing and memory systems can operate continuously.TheARM768E-Sis based on the ARMv5TEfive-stagepipeline architecture. Typically, ina three-stage pipeline architecture, while one instruction is being executed its successorisbeingde code and third instructions being fetched from memory. In the five-stage pipeline additional stages are added for memory access and write-back cycles. TheARM768E-Sprocessor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory restrictions or to applications where code densityisanissue.

The key idea behind THUMB is that of a super-reduced instruction set. Essentially, theARM768E-Sprocessorhastwoinstruction sets:

• Standard32-bit ARMv5TEset
• 16-bitTHUMBset

## 2. Temperature sensor:

TheLM35 pin diagram is shown in the figure 2 .As a temperature sensor, the circuit will read the temperature of the surrounding environment and relay temperature to us back in degrees Celsius. The LM35 is a low voltage IC which uses approximately +5VDC of power. This is ideal because the Arduino's power pin gives out 5V of power. The IC has just 3 pins, 2 for the power supply and one for the analog output. The output pin provides an analog voltage output that is linearly proportional to the Celsius (centigrade) temperature. Pin 2

gives an output of 1 millivolt per 0.1°C (10mV per degree). So to get the degree value in Celsius, all that must be done is to take the voltage output and divide it by 10-this give out the value degrees in Celsius.



**Figure 2.Temperature sensor LM35**

## 3. Humidity sensor:

Humidity is the presence of water in air. The amount of water vaper in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapour 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. Here we are using a resistive type of humidity sensor.



**Figure 3. Humidity sensor**

## 4. Fire sensor:

In the fire sensor, an efficient,inexpensive, easily-obtainable temperature sensing material is used. When the external heat is applied to the thermistor, it will generate voltage in the circuit. The output voltage from the

thermistor is given to the comparator for voltage amplification. This in turn helps in detecting a very small voltage changes which in turn detects all range heat variation.



**Figure 4: Fire Sensor**

## 5. DC motor:

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings.Motors are the devices that provide the actual speed and torque in a drive system. This family includes AC motor types (single and multiphase motors, universal, servo motors, induction, synchronous, and gear motor) and DC motors (brush less, servo motor, and gear motor) as well as linear, stepper and air motors, and motor contactors and starters.

## 6. UART communication:

Serial data communication uses two methods, asynchronous and synchronous. The synchronous method transfers a block of data (characters) at a time while the asynchronous transfers a single byte at a time. It is possible to write software to use either of these methods, but the programs can be tedious and long. For this reason, there are special IC chips made by many manufacturers for serial data communications. These chips are commonly referred to as UART (Universal Asynchronous Receiver-Transmitter) and USART (Universal Synchronous-Asynchronous Receiver-Transmitter). The ARM chip has a built-in UART.

## Data transfer rate:

The rate of data transfer in serial data communication is stated in bps (bits per second). Another widely used terminology for bps is baud rate. The baud rate used in this DHLS for data transmission is 9600.

## RS232 and MAX232 standards:

RS232 is the most widely used serial I/O interfacing standard. This standard is used in PCs and numerous types of equipment. However, since the standard was set long before the advent of the TTL logic family, its input and output voltage levels are not TTL compatible. In RS232, a 1 is represented by -3 to -25V, while a 0 bit is +3 to +25V, making -3 to +3 undefined. For this reason, to connect any RS232 to a microcontroller system we must use voltage converters such as MAX232 to convert the TTL logic levels to the RS232 voltage level, and vice versa. MAX232 IC chips are commonly referred to as line drivers.

MAX3232 is compatible with RS-232 standard, have dual transceiver. Each receiver converts TIA/EIA-232-E levels into TTL/CMOS levels. Each driver converts TTL/CMOS levels into TIA/EIA-232-E levels. The MAX3232 is characterized for operation from -40°C to +85°C for all packages.MAX3232 is purposed for application in high-performance information processing systems and control devices of wide application.

## 7. Zigbee Module:

The XBee/XBee-PRO RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band and are compatible with the following.

 ➤ Advanced Networking & Security
- Point-to-point topology
- point-to-multipoint topology
- Self-routing, self-healing and fault-tolerant
- mesh networking

> Low Power
  - TX Current: 295 mA
  - RX Current: 45 mA
  - Power-down Current: < 1 μA

## 8. Mounting Considerations:

The ZigBee modules were designed to mount into a receptacle (socket) and therefore do not require any soldering when mounting it to a board. The ZigBee-PRO Development Kits contain RS- 232 and USB interface boards which use two 20-pin receptacles to receive modules.
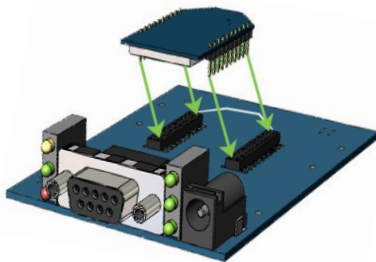


**Figure 5:** Mounting the Zigbee module

### 9.UART DATA FLOW:

Devices that have a UART interface can connect directly to the pins of the Zigbee module as shown inthe figure below.
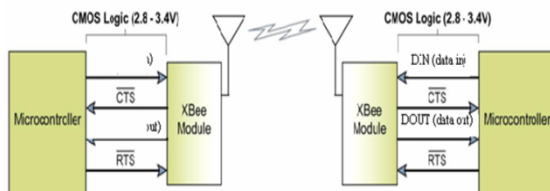


**Figure 6:** Zigbee UART Dataflow

The XBee modules maintain small buffers to collect received serial data, which is illustrated in the figure below. The serial receive buffer collects incoming serial characters and holds them until they can be processed. The serial transmit buffer collects data that is received via the tranceiver that will be transmitted out to the UART. So, the zigbee can do the transceiver operation.

## IV. System Software

### 1. OrCAD CAPTURE CIS

OrCAD Capture CIS is designed to reduce production delays and cost overruns through efficient management of components. It reduces the time spent searching existing parts for reuse, manually entering part information content, and maintaining component data. Users search parts based on their electrical characteristics and OrCAD Capture CIS automatically retrieves the associated part. Flexible and scalable, the solution is quickly implemented. OrCAD Capture CIS is ideal for individual design teams or multi-site teams who need to collaborate across multiple locations, OrCAD Capture CIS gives designers access to correct part data early in the design process and enables complete componentspecifications to be passed to board designers and other members of the design team, reducing the potential for downstream errors. It provides access to cost information so designers can use preferred, lower cost, and in stock parts. The embedded part selector accesses information stored in MRP/ERP systems and engineering databases and synchronizes externally sourced data with the schematic design database, so bills of materials can be automatically generated.

### 2. KEIL C COMPILER

Keil Software publishes one of the most complete development tool suites for 8051 software, which is used throughout industry. For development of C code, their Developer's Kit product includes their C51 compiler, as well as an integrated 8051 simulator for debugging. A demonstration version of this product is available on their website, but it includes several limitations

The purpose of this manual is to further explain the limitations of the Keil compiler, the modifications it has made to the C language, and how to account for these in developing software for the 8051 microcontroller.

### 3.FLASH PROGRAMMER

This ISP Programmer can be used either for in-system programming or as a stand-alone SPI programmer for

# International Journal of Research

**Available at https://edupediapublications.org/journals**

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

Atmel ISP programmable devices. The programming interface is compatible to STK200 ISP programmer hardware so the users of STK200 can also use the software which can program both the 8051 and AVR series devices.
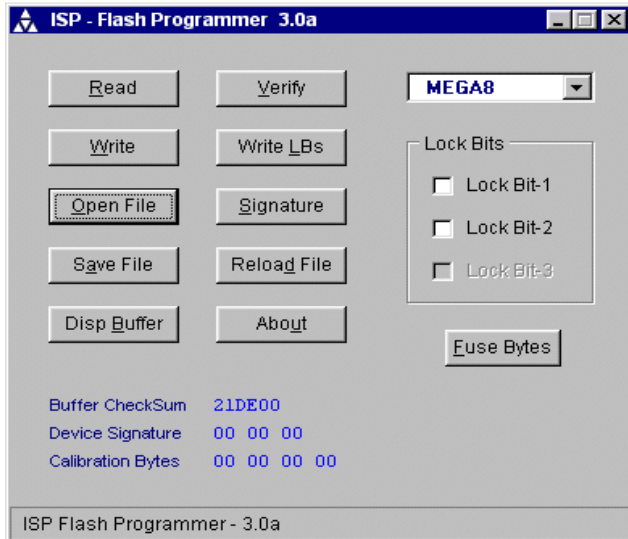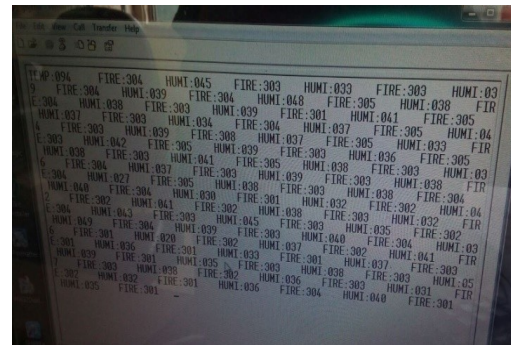


**Figure 1.Main screen of the program ISP-Flash Programmer- 3.0a**

## V. Results
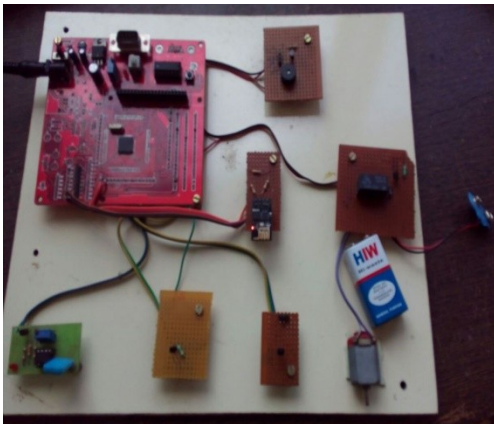


**Figure 1.Hard ware Peripherals**



**Figure 2.Output (Temperature, humidity, fire)**

## VI. Conclusion

The irrigation controller node is composed of a micro-processor, transceivers, analog to digital converters. Sensor nodes are deployed for field process monitoring and control. The proposed system makes remote monitoring possible in irrigation applications.

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