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Soil Communication Using Wireless Underground Sensor Networks

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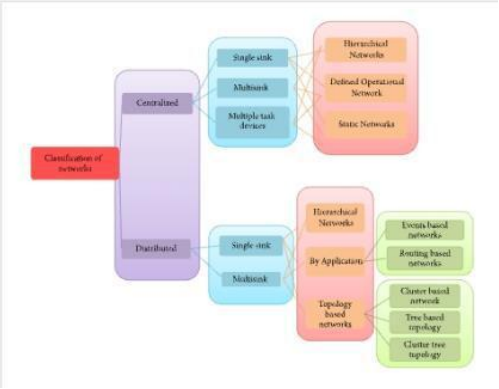
Abstract - Wireless underground sensor networks (WUSN) WUSNs, which have components, i.e. the sensors, that are buried underground and that communicate through soil. The majority of the applications for WUSNs – intelligent agriculture, environmental monitoring, of the soil. Our focusing area in this project is the measured moisture value in the soil is transmitted via the existing soil. We presents advanced channel models that were developed to characterize the underground wireless channel considering the characteristics of the propagation of EM waves in soil and their relation with the frequency of these waves, the soil composition and soil moisture.

1. INTRODUCTION

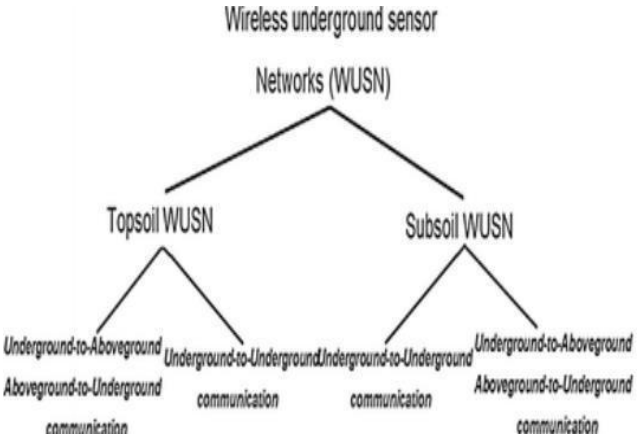
The world evolving day by day, technology creating a huge impact in daily life of an ordinary human. Wireless sensor will play an important role in each and every field. Wireless Underground Sensor Networks (WUSNs) constitute one of the promising application areas of the recently developed wireless sensor networking techniques. WUSN is a specialized kind of WSN that mainly focuses on the use of sensors at the subsurface region of the soil. For a long time, this region has been used to bury sensors, usually targeting irrigation and environment monitoring applications, although without wireless communication capability;



WUSNs promise to fill this gap and to provide the infrastructure for novel applications. The underground wireless channel was only available recently. COMMUNICATION through the underground medium has been a challenging research area. The applications require the deployment of sensors below the ground surface. Hence, the sensor become part of the sensed environment and might deliver more precise sensing.

2. Proposed System

WUSN environments are more complicated than aboveground environments as they contain air, sand, rocks, and water with electrolytes. It is challenging to realize wireless communication in such complex environments. Classic techniques based on EM waves are widely used in terrestrial environments. However, those techniques do not work well in underground scenarios. First, EM waves experience high levels of attenuation due to absorption by soil, rocks, and water underground. Second, the electrolytes in the underground medium become the dominating factor that influences the path loss of EM waves. As a result, soil water content, density, and makeup can affect the performance of communication unpredictably since these factors change with location and vary dramatically over time. Third, operating frequencies in megahertz or lower ranges are necessary to achieve a practical transmission range. Thus, compared with the communication range, the antenna size will become too large to be deployed underground. WUSN Node section: The models developed in this characterize not only the propagation of EM wave in soil, but also other effects on the communication related to multi path effects, soil composition, water content, and burial depth. The results obtained from this formalization reveal that underground communication is severely affected by frequency and soil properties, and more specifically by the volumetric water content (VWC) of soil. Moreover, the effects of weather and season changes are investigated by considering two soil types as examples.



(a) Wireless underground sensor network

Such theoretical models are essential for laying out the foundations for efficient communication in this environment. In particular, the 300 – 900 MHz frequency band, which is suitable for small size antenna and sensor development, is investigated and the results of field experiments realized at 433 MHz are compared with the theoretical models. Moreover, the realization of field experiments also revealed important issues not considered in the theoretical models, such as the effects of the antenna orientation. Finally, challenges for the feasibility of WUSNs are highlighted. Correspondingly, the design rules for optimum MI-WUSNs have been shown to substantially differ from the design rules for the traditional wireless communication systems due to unique properties of the transmission channel. In this paper, the recent advances in the area of MI-WUSNs are discussed, which range from signal transmission techniques and network design to wireless data transmission and localization.

3. WUSN MODULE:

3.1 FEATURES:

Input voltage**:** 5v

Analog output

Low cost and long life

Compatible with most I/O ports interface

3.2 APPLICATIONS:

We classify current and potential underground applications into four

categories:

- Environmental monitoring
- Infrastructure monitoring
- Location determination
- Border patrol and security monitoring

4. UART BOARD

4.1 GENERAL DESCRIPTION

UART board is used to receive the data from the wireless communication devices and transmit the data in to a serial format. It is provided with a DB9 female port along with a data driver. This board has a filtering unit to reduce the unwanted noise in data transmission.

4.2 PRODUCT DESCRIPTION

A Universal Asynchronous Receiver and Transmitter (UART) board is a hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable. UART takes bytes of data and transmits the individual bits in a sequential fashion. Each UART contains a shift register, which is the fundamental method of conversion between serial and parallel forms. A UART usually contains the following components are a clock generator, input and output shift registers, transmit/receive control, read/write control logic. Serial transmission of digital information (bits) through a single wire or other medium is less costly than parallel transmission through multiple wire.

4.3 FEATURES

Supply voltage: 5VDC

Compatible with all microcontrollers

Data transmission is quiet accurate

Provided With DB9 Female connector

4.4 APPLICATIONS

Serial communication applications

Wireless communications

5. TEMPERATURE SENSOR

5.1 GENERAL DESCRIPTION

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

The LM35 device 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°C to 150°C temperature range. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

5.2 PRODUCT DESCRIPTION

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in **o**C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 **o**C temperature rise in still air. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range

5.3 FEATURES

Calibrated Directly in Celsius (Centigrade)

Linear + 10-mV/°C Scale Factor

0.5°C Ensured Accuracy (at 25°C)

Rated for Full −55°C to 150°C Range

Suitable for Remote Applications

5.4 APPLICATIONS

Power Supplies

Battery Management

HVAC

Appliances

6. LCD

6.1 GENERAL DESCRIPTION

LCD stands for liquid crystal display. They come in many sizes 8x1 , 8x2 , 10x2 , 16x1 , 16x2 , 16x4 , 20x2, 20x4,24x2 , 30x2 , 32x2 , 40x2 etc . Many multinational companies like Philips Hitachi Panasonic make their own special kind of LCD'S to be used in their products. All the LCD'S performs the same functions (display characters numbers special characters ASCII characters etc).Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15). Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc.

6.2 PRODUCT DESCRIPTION

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multi programmer or a 5V fixed regulated power supply. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. A full list of the characters

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File Edit Format View Help

```
#include <htc.h>
#include "lcd16.h"

void txs(unsigned char val)
{
int i;
while(!TXIF)
        continue;
TXREG=val;
for(i=0;i<1200;i++);
}

void delay2()
        {
        long i;
        for(i=0;i<10000;i++);
        }

unsigned char rxs(void)
{
int c=0;
while(!RCIF)
        {
```

```
                c++;
                        if(c>5000)
                                break;

        }
return RCREG;
}

unsigned char val[6],flagx=0,val1,val2,val3,val4,val5;

int j=0;

int x;
int sp,sp1,spt;



        unsigned int d=0,e=0,f=0,flgg=0;
        unsigned int m=0;


void Delay()
{
```

6.3 FEATURES

Input voltage: 5v

E-blocks compatible

Low cost

Compatible with most I/O ports in the E-Block range

Ease to develop programming code using Flow code icons

6.4 APPLICATIONS

Monitoring

```
                c++;
                        if(c>5000)
                                break;

        }
return RCREG;
}

unsigned char val[6],flagx=0,val1,val2,val3,val4,val5;

int j=0;

int x;
int sp,sp1,spt;



        unsigned int d=0,e=0,f=0,flgg=0;
        unsigned int m=0;


void Delay()
{
```

7. MICROCONTROLLER

7.1 GENERAL DESCRIPTION

The microcontroller is a device that can perform a specific

function according to the coding/program burnt into its program memory. The microcontrollers are special purpose devices used in many application like automobile, medical, instrumentation, battery management, smart phones accessories, motor and control drives, USB

and wireless technology etc. One of the most reputed manufacturers of micro-controller is

MICROCHIP. PCB design. They have the vast series of micro controllers from 8bit, 16, 32 bit controllers both in SMD and through whole package.

7.2 PRODUCT DESCRIPTION

This board is build with PIC16F877A as a microcontroller unit. The input supply to the board can be fed from both ac and dc. It uses a crystal oscillator for generating frequency. A serial communication is achieved by an UART protocol. This board is specially designed for connecting digital and analog sensors which has input voltage range 5

or 12VDC as well as it can be interfaced with serial communication devices, relay boards etc. The output can be monitored in LCD as well as pc. Data EEPROM is used to store data defined by the user. PCB design. When a variable is defined it is stored in program memory and

The value of the variable is stored in data EEPROM Synchronous serial ports are used to communicate with other peripheral devices like serial EEPROMS, A/D convert PIC assembled PCB and shift registers. PCB design. They have two modes. 1- SPI Serial Peripheral Interface 2- I2C Inter Integrated Circuit

7.3 FEATURES

Input Supply: Ac or Dc (9 to 12v)

8bit LCD

RS232 output

Analog channel: 5 sensor inputs

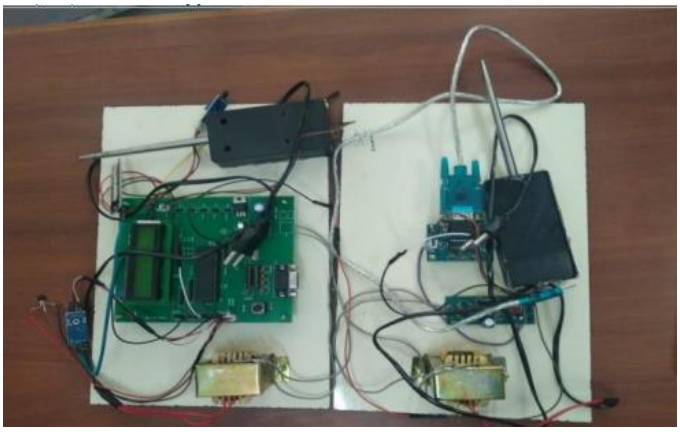
Crystal frequency: 4mHz

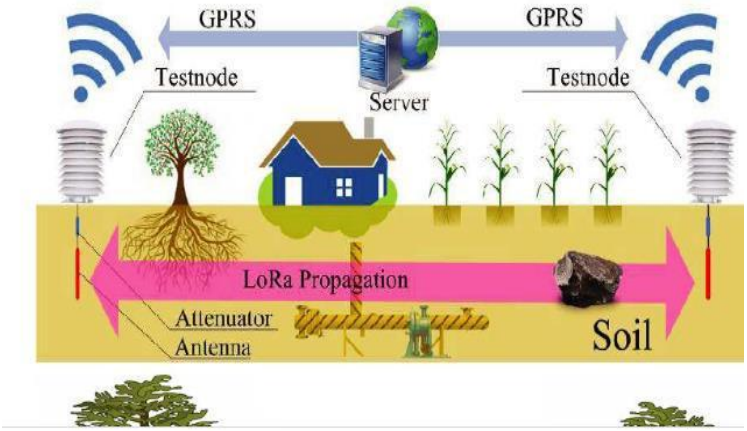
7.4 APPLICATION

Real time applications

Academic applications

PIC ASSEMBLED PCB+UART+LCD





8. CONCLUSION

In this paper we have described about soil communication using wusn, it has the transmitting and receiving antenna which are the main factor of finding the data of the soil using PIC16F877A

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