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Real Time Wireless Flood Monitoring System Using Ultrasonic Waves

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Abstract: ***The purpose of this project is to develop a real time wireless flood monitoring system by using the concept of the ultrasonic waves. Everything in the modern human life has undergone rapid development. This development is supported by the advance of electronics and information technology, so we have built a system which can automatically sense the water level and then send this value to the control room through the wireless system to display it on LCD, Then depending on the measurements of the previous years for the same river we also have a set of LEDs to show that the current value of the water level located in which area. This research developed by using ATMEGA32 microcontroller.***

Keywords: water level measurement; Ultrasonic ranging module HC - SR04; ATMEGA32 microcontroller

1. Introduction

The monitoring of the water level in a river or in a reservoir is important in the applications related to agriculture, flood prevention, and fishing industry, etc. The schemes developed for measuring water level can be categorized as four types based on the measuring features such as pressure, ultrasonic waves, heat, and image.

Almost all aspects of human life have undergone rapid development. This development is supported by the advance of electronics and information technology. The job can be performed on schedule precisely and efficiently by adopting this advance technology.

An achievement in computer technology is used not only in business and industry but has also covers almost all fields, including control system where a computer system can be used to control the hardware in a flexible way. Therefore, computer based control system is become more common in recent development of control system.

Computer-based control system also can be implemented for optimizing river flow management to minimize flood caused by water overflow. Management can be performed based on elevation of water level on the river as an input data and control the sluices along the river stream based on that data.

In this project we will use the concepts of the ultrasonic waves. An ultrasonic level or sensing system requires no contact with the target. For many processes in the medical, pharmaceutical, military and general industries this is an advantage over inline sensors that may contaminate the liquids inside a vessel or tube or that may be clogged by the product.

Both continuous wave and pulsed systems are used. The principle behind a pulsed-ultrasonic technology is that the transmit signal consists of short bursts of ultrasonic energy. After each burst, the electronics looks for a return signal within a small window of time corresponding to the time it takes for the energy to pass through the vessel. Only a signal received during this window will qualify for additional signal processing. Ultrasonic wave sensor is free from water pressure since it measures the time of travel of ultrasonic wave pulse from transmitter to receiver reflected by the water surface.

2. Objectives of the Project

There are some objectives need to be achieved in order to accomplish this project. These objectives will act as a guide and will restrict the system to be implemented for certain situations:

a) To develop a model of REAL TIME WIRELESS FLOOD MONITERING SYSTEM by using the ultrasonic sensor to measure the water depth in the river.
b) To send this value of water level from the transmitter module to the receiver module in the control room using the RF module.
c) To display the water level using an LCD. Then Depending on the measurements of the previous years for the same river we also have a set of LEDs to show that the current value of the water level located in which level.
d) To use BASCOM-AVR software to generate a computer program for the microcontroller in order to get signal for the real time.

3. Project Description

The aim of this project is to develop prototype of water level detection that can be viewed as a part of control system of river flow management system. The system consist of two parts, transmitter and receiver modules. Transmitter module detect water level automatically, then transmit the data to receiver. Ultrasonic sensor is used to detect the distance between sensor and the water surface. Water level detection is performed without physical contact between the sensor and water surface. Ultrasonic sensors utilize the principle of sound reflection to measure the level of the water. Elapsed time required to transmit and receive the reflected ultrasonic wave is multiplied by the rapid propagation of sound in water in order to obtain the distance value.

The calculation is performed by high level language program that reside in microcontroller. The distance value then is transmitted using wireless network (RF transmitter).

In receiver module, distance value received through the wireless network (RF receiver) is passed to another microcontroller to display the water level using an LCD. Then depending on the measurements of the previous years for the same river we also have a set of LEDs to show that the current value of the water level located in which area:

a) LEDs with a green color mean that the water level is still in the safe level.
b) LEDs with a yellow color means that the water level in the area between the safe level and the level of risk.
c) LEDs with a red color mean that the water level has reached the level of risk (flood level).
d) Then if the water level is changed rapidly and considerably dangerous, the buzzer will be activated.

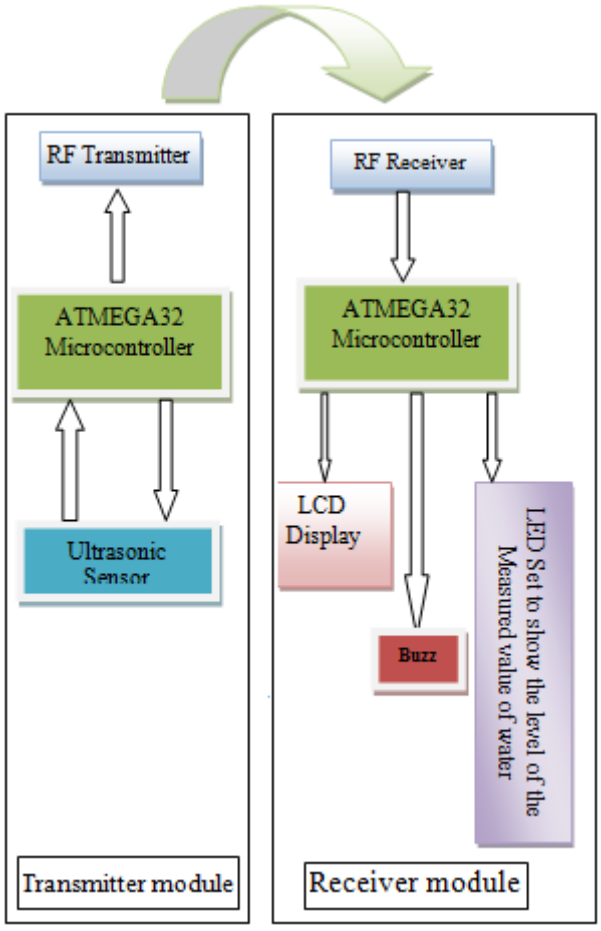

Figure 3.1: Block Diagram of the System

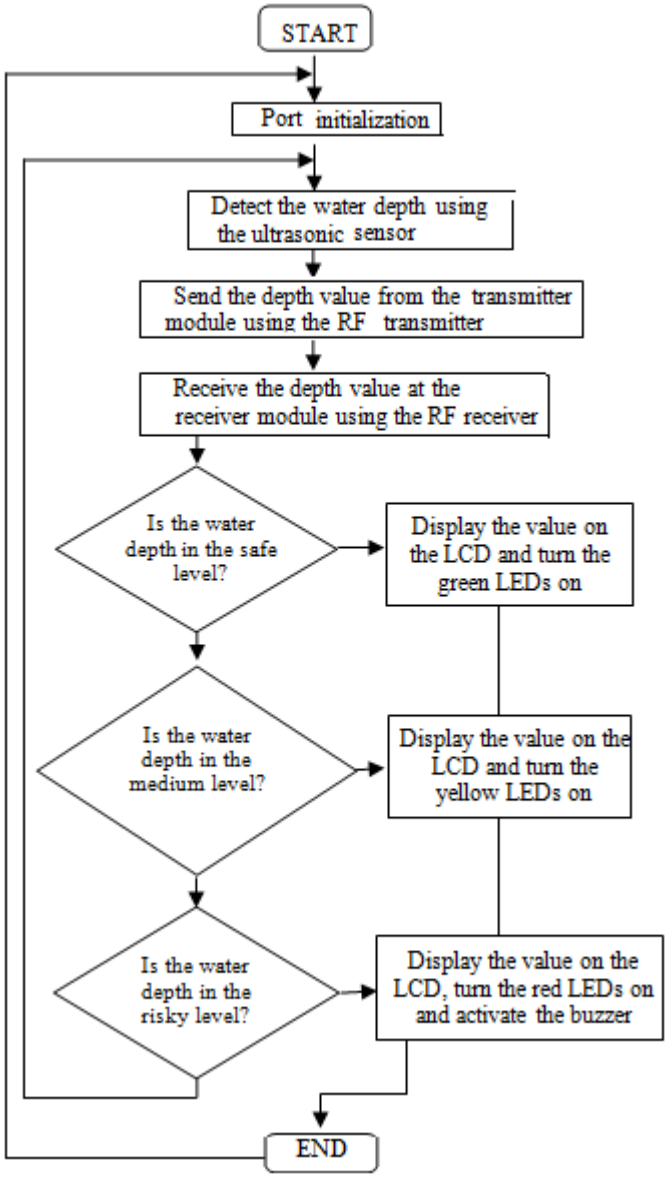

Figure 3.2: Software Structure Flowcharts

4. Hardware Design

The system performs the remote sensing and remote control activities without the manual observation and attention in the site. Being an automatic system unavailing manpower and providing information for long period of time. The real time wireless flood monitoring system has the following main components:

The sensor:
A sensor is a device which measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. In this project we use the ultrasonic sensor which work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. We will use the Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging

accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work is:

1. Using IO trigger for at least 10us high level signal,
2. The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
3. IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
4. Distance = (high level time × velocity of sound (340M/S) / 2.

Figure 4.1: the Ultrasonic Ranging Module HC - SR04

5. Microcontroller

A microcontroller is a compact standalone computer, optimized for control applications. Entire processor, memory and the I/O interfaces are located on a single piece of silicon so, it takes less time to read and write to external devices. In this project we use The ATmega32 which is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

5.1 The RF module

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

For the RF module I select the nRF24L01 is a single chip 2.4GHz transceiver. To design a radio system with the nRF24L01, you simply need an MCU (microcontroller) and a few external passive Components. The nRF24L01 module is works at 1.9 up to 3.6 voltage level.

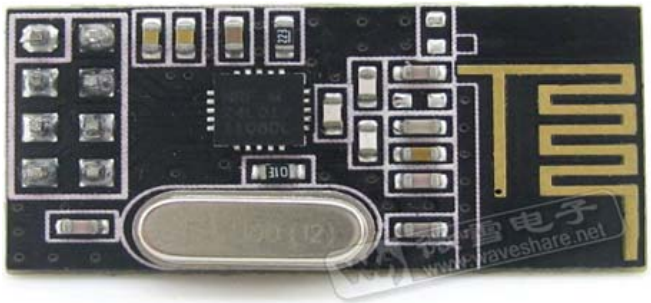

Figure 4.2: The nRF24L01 2.4GHz transceiver

5.2 Liquid Crystal Display (LCD)

LCD is the most common message display device used to display ASCII character. LCDs have become a cheap and easy way to get text display for embedded system. The Common displays are set up as 16 to 20 characters by 1 to 4 lines.

a) Light Emitting Diode (LED)

LED is a semiconductor light source. LEDs are used as indicator lamps in much electronic circuit.

b) The buzzer

It is an electronic used to give alarm sound as it is programmed.

6. Project Simulation

Using PROTEUS VSM software, now it is possible to draw a complete circuit for a microcontroller based system and then tests it interactively. With PCB layout the software now also offering automation of both component placement and track routing, getting the design into the computer can often be the most time consuming element of the exercise. And if you use circuit simulation to develop your ideas, you are going to spend even more time working on the schematic.

So when we simulate our program which had written in BASCOM language, and as we wrote before that we will always show the water level on the LCD and we will turn - on and off- the set of the LEDs according to this value.

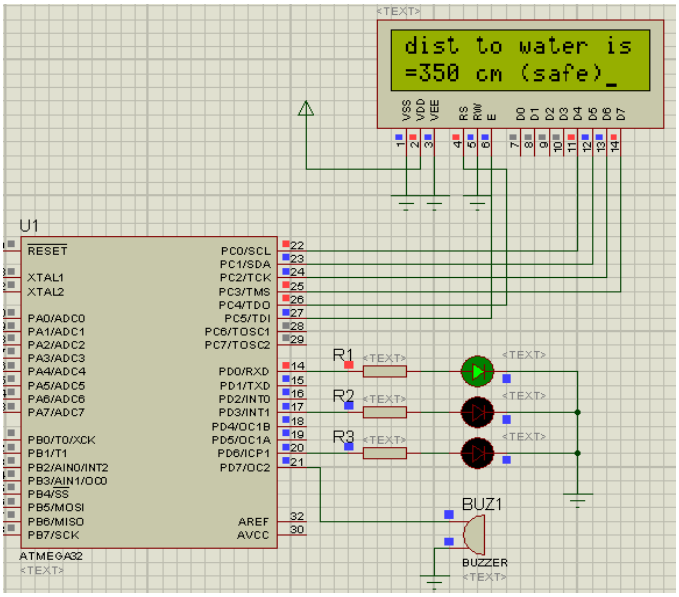

Figure 5.1: The safe level display

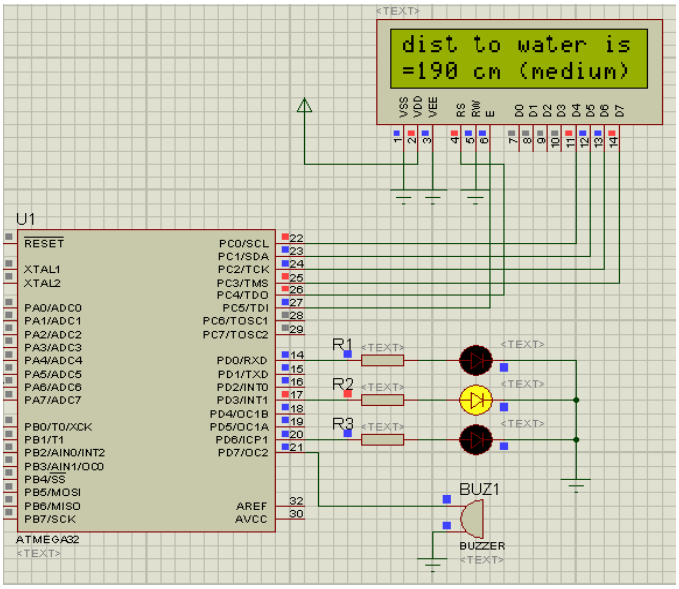

Figure 5.2: The medium level display

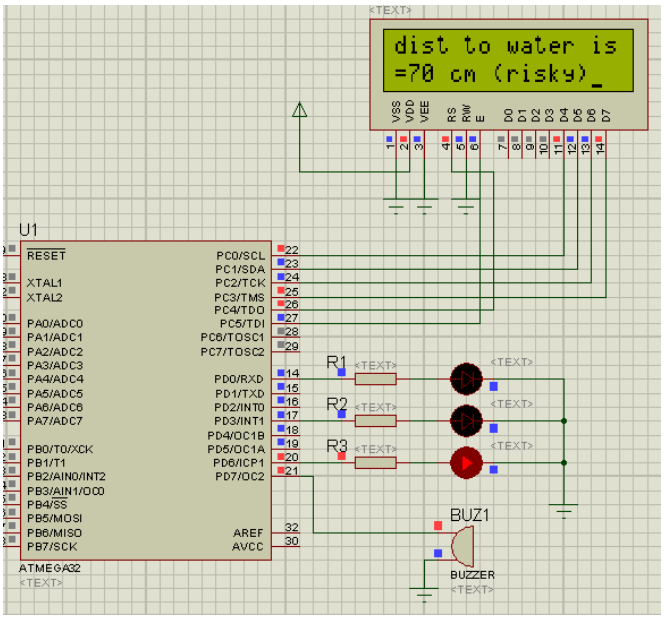

Figure 5.3: the risky level display

7. Conclusion

This project has achieved the main objectives. Moreover, this project involved designing and development of real-time wireless flood monitoring system had exposed to the better way of software and hardware architecture that blends together for the interfacing purposes. The system employs the use of advance sensing technology in performing real-time monitoring of water level. The developed system is composed of three major components: 1) sensor network, 2) transmitting modules and 3) processing the data .The sensor network measures the water level data while the transmitting module is used to transmit measured data to the Receiver module where these data will be processed

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