Quit the Project of the Development of A Device for Measuring Water Level Based on Ultrasound and Radio Wave

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ABSTRACT

This article explores possible solutions in order to use ultrasound to accurately measuring of groundwater level or water levels in the environment. The model we provide, the highly integrated A9 GPRS Module microcircuit, can be used in a number of processes and allows for systematic temperature coupling adjustment or the construction of curves that are simple to reset. A number of applications call for the use of the A9, an ultrasonic sensor for proximity and level sensing. A number of variables can be considered to enhance the performance of the model, including the frequency of operation, power supply voltage, transducer size and shape, and the model of signal processing techniques employed. The A9 model can be improved by experimenting with various transducer sizes and shapes to ascertain.

Keywords :

I. Introduction

Meanwhile the founding of our republic, significant efforts have been made to assess and effectively monitor underground water resources, develop and introduce phenomena and processes in challenging hydrogeological conditions, and achieve specific outcomes. In this regard, it is possible to highlight several scientific studies aimed at enhancing the geofiltration procedures of regional hydrogeological regions based on the information supply of the mathematical model, the capacity to ascertain the state of the hydrogeological region, and the prediction of the parameters of the underground hydrosphere. The establishment of efficient management systems for water resources in necessary instances, quick analysis of changes in flood waters, and mathematical modelling of geofiltration processes of regional hydrogeological regions.

Scientific and practical work has been carried out in our country and in the world on the use of automated methods of measuring the environmental condition of hydrogeological objects and the characteristics of the hydrogeological regime, and large-scale work is being carried out on their further development and improvement. In developed countries, including the USA, Germany, Canada, Denmark, Japan, France, Australia, Russia, computerized measurement methods are widely used in the management of phenomena and processes occurring in complex hydrogeological conditions [1]

II. Main Part

Using the A9 model to optimize the placement of the sensor on the object ARM

Cortex-A9 module can be used to solve these problems. Texas Instruments announced officially the launch of the OMAP4440 applications processor, with impressive performance enhancements when compared to the company's CPU's. Among these improvements, we were counted the speeds of 1.5 GHz per ARM Cortex-A9 MPCore the new CPU can achieve. The module uses advanced signal processing techniques and a built-in digital signal processor (DSP) to provide high accuracy and reliable measurements while being compact, low power consumption.

This module works by propagating ultrasonic waves in structures and measuring the return time of the waves. The module then calculates the distance based on the propagation time of the ultrasonic waves and the speed of sound in the medium (air, water or solid materials).

This method has several advantages over other remote sensors such as infrared, laser or radar sensors. For example, ultrasonic waves are not affected by ambient light, dust or smoke, which can interfere with the operation of other sensors. Ultrasound waves can also pass through certain materials, such as plastic or glass, allowing you to detect objects behind barriers.

The A9 module can be optimized for different applications by adjusting various parameters such as ultrasound frequency, power and sampling rate, echo pulse width, and data processing algorithm. The module can also be adjusted to account for temperature, humidity and other environmental factors that can affect the accuracy of measurements.

Non-contact measurement of water level in wells is to increase the distance and accuracy. This is achieved by simultaneously creating a sound and radio wave in the well, which is the starting point for the travel time of the sound wave from the wellhead to the water table, measuring and adjusting the travel time of the sound wave. taking into account the ambient temperature, the speed of sound in the gas environment, then determining the distance according to the formula D= Vs(0C)×T, where D is the distance from the mouth to the water surface, Vs. (0C) is the speed of sound in a gaseous medium taking into account the temperature of the propagation medium, T is the propagation time of the sound wave from the mouth to the water surface. Figure 1 shows the implementation diagram of the proposed method.

1-Transceiver (receiver of radio waves);

2- transmitter of ultrasound (transmitter);

3- Ultrasound receiver (receiver);

4- microcontroller control on the water surface (floating part);

5- Wellhead control microcontroller - main;

6- I2C temperature sensor

7- soil (ground level);

8- well wall;

9 - water surface at the bottom of the well; 10 - holding line.

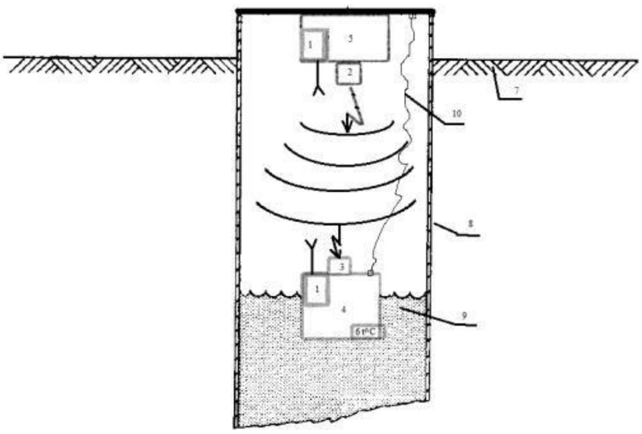


Figure 1. Block diagram of the method of measuring the water level in the well.

A radio wave propagates in a gaseous medium at a speed of 3×108 m/s, i.e. practically at the moment the receiver reaches the radio receiver of 1, the microcontroller wakes up and the Timer of the Floating part of the microcontroller is also turned on, and the sound wave propagates at a speed of 3 × 102 m / s, i.e. By turning on the timer T2, the floating part of the radio wave is 6 degrees smaller than the radio wave, which allows you to receive the beginning of sound vibrations with the time of arrival of the radio wave to the radio receiving system of the 1st receiver. The sound wave arrives at the ultrasound receiver 3 and turns off the timer by setting the time T2, and at the same time a response radio wave is sent to complete the countdown time T1 in the timer of the main stationary part. So it's on. both microcontrollers 4 and 5, the time for the sound wave to travel from the mouth to the well fluid level T1 and T2. This two-way measurement eliminates accidental measurement and increases accuracy.

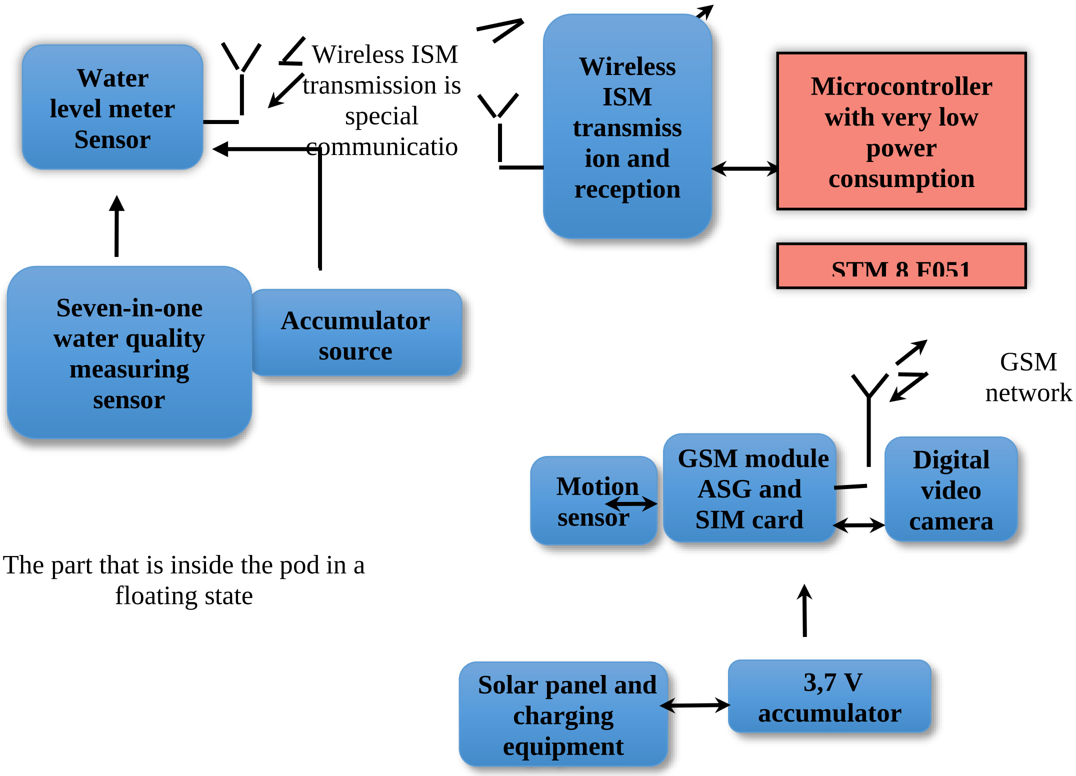
The formula for calculating the speed of sound in air:

$$v = \frac{331m}{s} + \frac{0,6m}{s°C} * T \ (1)$$

Here V is the speed of sound in meters per second and T is the temperature in degrees Celsius.

Sound and heat are both kinetic phenomena, whereby an increase in temperature causes an increase in the rate of molecular vibration. Due to the vibrations of the molecular vibration, sound waves can travel at a speed of 300 to 400 m / s. Due to the dependence on temperature (T), we use 1 °C to calculate the speed of sound in air (v). Knowing the sound wave transit time and the speed of sound in the gas environment according to the timers, the distance from the liquid level to the mouth is determined by the formula, taking into account the temperature sensor readings. D= Vs(0C)×T. In this mode, the operation method is carried out in several years, i.e. The service life of the batteries of the floating part is equal to the period of overhaul of the wells. There is a holding connector (10) for lifting and holding the floating part. Thus, the floating part is raised with it and the batteries are replaced.

The proposed method has the feature of measuring the distance to distant objects compared to the known ones, because it takes advantage of the direct measurement method and takes into account the ambient temperature. and it increases the reliability. It is intended to use the proposed method in determining the water level of hydrostatic wells.



The part that is inside the pod in a floating state

The main module in front of the trench

Figure 2. Block diagram of the developed device

The device is floating inside the pod, the parts are wireless ISM transmission special communication, the parts are water level meter sensor, water quality detector, seven-in-one measurement, battery source, wireless ISM transmission special communication, wireless ISM transmission and reception, o The low-power controller consists of STM8F051 microcontroller, motion sensor, GSM module, SIM card, digital video camera, solar panel, power module and 3.7 V battery. Long-range detection must take into account the attenuation of ultrasonic energy through air. The rate of attenuation depends primarily on frequency. The relationship between the frequency of the structure and the maximum detectable distance is presented as follows:

↑ Frequency :: ↑ Resolution :: ↑ Narrower Directivity :: ↑ Attenuation :: ↓ Distance Ultrasonic energy does not propagate linearly over distance. Figure 1.1 shows the attenuation of sound pressure with distance and frequency. The advantages of high-frequency designs are increased accuracy and directivity (forward beam pattern), but the disadvantage is increased attenuation. The degree to which ultrasound sensor energy undergoes scattering and absorption during propagation through air increases with frequency, and therefore the maximum detectable distance decreases.

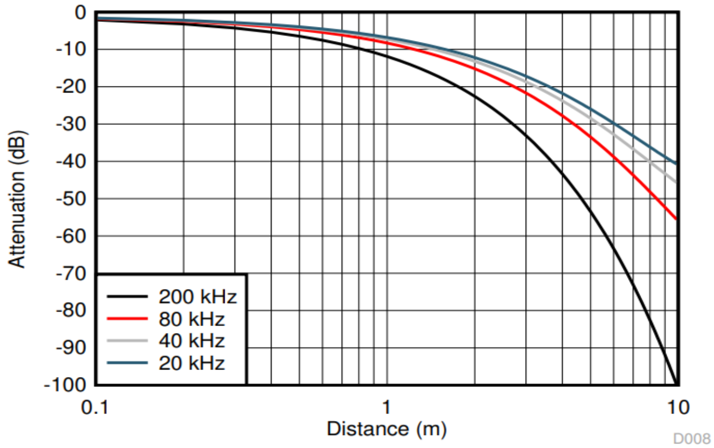


Figure 3. Properties of sound pressure attenuation over distance

Targets and objects to be detected: The signal emitted by the ultrasonic sensor affects the echo force that returns to the target point where the sound is reflected. For example, a large, flat steel wall will reflect more echoes than a narrow tree. This difference, the ratio of the pressure on an imaginary surface in a sound wave to the speed of particle flow across the surface, is due to a combination of the orientation and the maximum cross section of the target.

Acoustic - in other words, acoustic impedance is a property of a material that describes how much it "pushes back" sound waves trying to pass through it. Materials with high acoustic impedance tend to reflect more sound energy than they transmit, while materials with low acoustic impedance tend to transmit more sound energy than they reflect. resistivity is based on the density and acoustic velocity of a given material, and it is important to determine the amount of reflection that occurs at the boundary of two materials with different acoustic resistivities. The acoustic resistance of air is four times smaller than that of many liquids or solids; therefore, most of the ultrasound energy is reflected into the tissues based on the difference in reflection coefficients, but lighter materials with low density or significant amounts of air voids such as sponges, foams, and soft woven fabrics generally absorb more ultrasound energy. Table 1 shows a sample list of the characteristics of various material types as they relate to ultrasonic absorption by air.

Table 1: The ability to transmit sound waves in different materials.

Materials	**Density (kgm^{-3})**	**Speed of sound (ms^{-1})**	**Acoustic resistance ($kgm2_s\ ^{-1}x10^5$)**
Air	1.3	330	0.000429
Sponge	100	750	0.075
Oil	925	1450	1.38
Water	1000	1450	1.45
Soft tissues	1050	1500	1.58
Muscle	1075	1590	1.70
Aluminum	2700	6320	17.1
Steel	7800	5900	46.02
Iron	7700	5900	45.43
Gold	19320	3240	62.6

The acoustic resistance of a material is a measure of its ability to transmit sound waves. It is defined as the density of the material and the speed of sound in the material.

Acoustic resistance values for some common materials are in Table 1:

III. Environmental application process

Changes in temperature, humidity and air pressure, speed of sound, transmission resistance characteristics of the structure reflect the resistance characteristics of the equipment, such as a variable parallel load in the structure. Temperature has the greatest effect on the performance of ultrasonic sensors.

Table 2 Sound speed at air temperature

Table 2 shows the speed of sound over temperature. As can be seen from the table, as the temperature increases, the speed of sound increases. 0 °C speed of sound at temp 331 m/s will be 10 °C speed of sound at 337 m/s increases at

Temperature °C	**Speed of Sound** (m/s)
-40	307
-30	313
-20	319
-10	325
0	331
10	337
20	343
30	349
40	355
50	361
60	367
70	373
80	379
90	385
100	391
110	397
120	403

VI. Acknowledgment

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