Experiments of Recreating The Frequency Domain Properties of Seawater Channel For Underwater Communication

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Abstract- *Water data communication is a potential technology to realize underwater communication. The experiment of underwater data communication in the laboratory is different with that in the real water environment because the physical scale is limited. Although since recent several decades, artificial scattering agents are used to recreate underwater data communication through water channels under different communication medium conditions, but the similarity between experimental water and natural water is not reliable, such as the similarity in frequency domain characteristics.*

In this project, several kinds of agents are evaluated to change the coefficients of experimental water precisely. Then, seemed as criterion for the reliability of water recreation, the frequency domain characteristic of data communication through water channel in experimental water is measured and compared. The results show that the type and particle size of the agents will significantly affect its water properties, and the frequency domain component of the water communication signal will be affected by the agents concentration.by having a separate TX and RX module in the water between the modules we can transmit the sea researchers biomedical conditions and interactions to the monitoring end available on the ship.

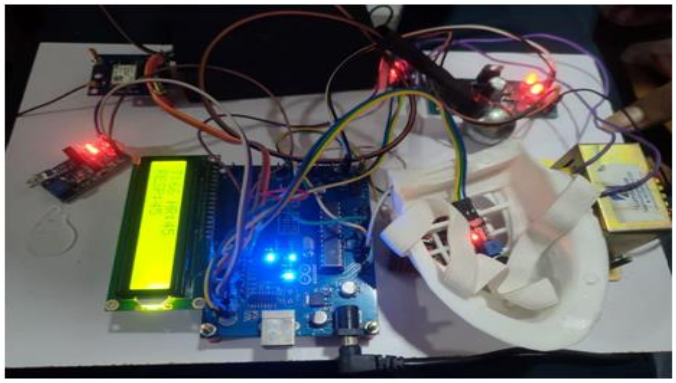
Keywords- Water communication, heart rate, respiration, body temperature.

I. INTRODUCTION

Underwater data communication holds immense promise for various applications, yet replicating real-world conditions in laboratory settings poses challenges due to limited physical scale and inaccuracies in mimicking natural water environments. Despite efforts to simulate underwater channels using artificial scattering agents, the reliability of these recreations, particularly in terms of frequency domain characteristics, remains questionable. This project aims to address this gap by meticulously evaluating various agents to precisely alter the coefficients of experimental water. The criterion for assessing the fidelity of water recreation lies in comparing the frequency domain characteristics of data communication in experimental water with those in natural water environments. Results indicate that the type and particle size of agents significantly influence water properties, impacting the frequency domain components of communication signals. By employing separate transmission (TX) and reception (RX) modules submerged in water, this technology offers the potential to relay crucial biomedical data and interactions of sea researchers to monitoring stations aboard ships, thus enhancing underwater communication efficacy and facilitating real-time data exchange in marine research settings.

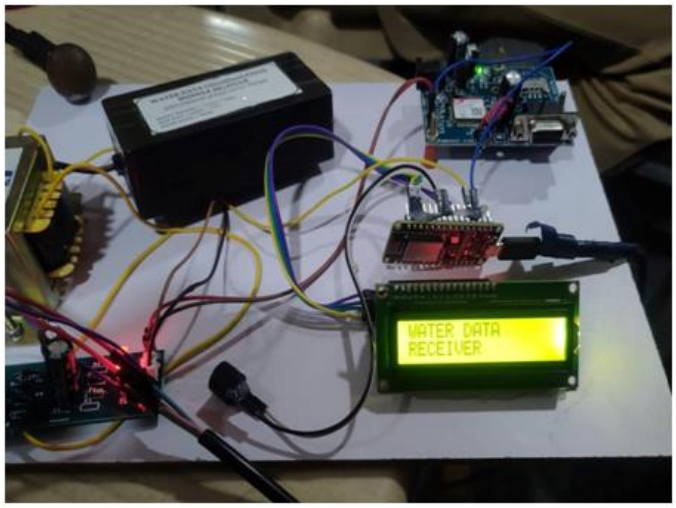
1. TRANSMITTER MODULE

This module consists of the Arduino microcontrollers, which control the transmission section. It includes sensors such as the DHT11 for detecting body temperature, a heart rate sensor for detecting heartbeat, and a respiration sensor for measuring respiratory values. These sensors collect data on theperson's vital signs, which are then transmitted through thewater using an underwater communication module. Additionally, a GPS module is interfaced with the transmitter module to determine the person's exact location. In case of emergency, there's a push button acting as an emergency button to trigger an alert. This module also incorporates an underwater transmitter module that generates an electromagnetic field underwater to facilitate communication.



2. RECEIVER MODULE

The Receiver Module is equipped with an underwater receiver module to capture the data transmitted through the water. It receives the vital sign data from the transmitter module and displays it on a Liquid Crystal Display (LCD) using the I2C communication protocol. The LCD provides real-time monitoring of the person's parameters, allowing for immediate assessment of their health status. Furthermore, if any abnormalities are detected, the receiver module can receive the person's exact location automatically, which can be crucial for timely intervention.



3. ULTRASONIC SENSOR MODULE

The Monitoring Module enhances the system's functionality by incorporating a Global System for Mobile communication (GSM) module. This module enables the system to send alerts or messages to a particular registered mobile number in case of any detected abnormalities in the person's vital signs. It serves as an additional layer of notification, ensuring that relevant parties are promptly informed of the individual's health status, allowing for appropriate action to be taken if necessary.

4. ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Youcan tinker with your UNO without worrying too much about doing something wrong, worstcase scenario you can replace the chip for a few dollars and start over again.

5. HEART BEAT SENSOR

To get a real heartbeat from this could be challenging. The KY-039 Heartbeat Detector uses a very high resistance resistor R1, because most of the light through the finger is absorbed, it is desirable that the phototransistor is sensitive enough. The most important is to keep the shield stray light into the phototransistor. For home lighting that is particularly important because the lights at home mostly based 50HZ or 60HZ fluctuate, so faint heartbeat will add considerable noise.

6. TEMPERATURE SENSOR

The temperature-sensing element is then buffered by an amplifier and provided to the VOUT pin. The amplifier has a simple class A output stage with typical 0.5-Ω output impedance as shown in the Functional Block Diagram.Therefore the LM35 can only source current and it's sinking capability is limited to 1 μA.

7. WORKING OF GPS

GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive a transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it electronically to measure your running route, map a golf course, find a way home or adventure anywhere.To calculate your 2-D position (latitude and longitude) and track movement, a GPS receiver must be locked on to the signal of at least 3 satellites. With 4 or more satellites in view, the receiver can determine your 3-D position

(latitude, longitude and altitude). Generally, a GPS receiver will track 8 or more satellites, but that depends on the time of day and where you are on the earth. Some devices can do all of that from your wrist.

8. GSM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands always start with AT (which means Attention) and finish with a <CR> character.

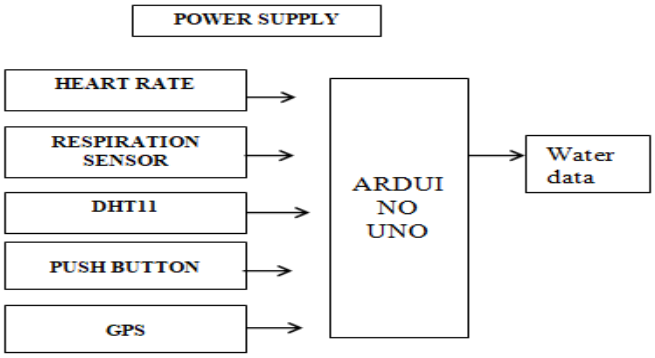
9. BUZZER

A buzzer or beeper is an audio signaling device, whichmaybe mechanical, electromechanical,or piezoel ectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

II. WORKING PRINCIPLE

In this system, ARDUINO and ESP8266 microcontrollers are control transmitter and receiver section. DHT11 detects body temperature of the person. Heart rate sensor detects heartbeat of the person. Respiration sensor detects respiratory value of the person. These three parameters will automatically send to receiver section through the water with the help of underwater communication module. The transmitter module has underwater transmitter module. It generates electromagnetic field under the water. The receiver section has underwater receiver module. It will receive the data using this module. To navigate the person, the GPS module interfaced with transmitter module. It gets the exact location of the person with the help of this module. If any abnormality found from the person, the location of the person will automatically send to receiver module. Push button acts as an emergency button. If any emergency to this person, he will press it and his exact location will be sent to the receiver section. I2C communication protocol is used to send the data to LCD display. Liquid Crystal Display (LCD) is used to display the parameter of the person in receiver section.

III. BLOCK DIAGRAM



Figno.1.1Transmitter

FLOW DIAGRAM

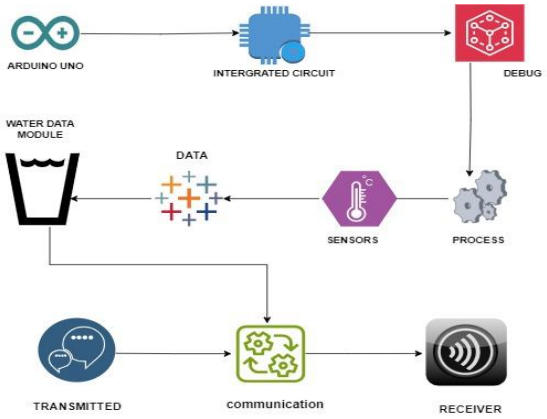


Fig.1.3.Reciever

The Temperature ,Heart rate, Respiration value, Location shown in the display and the signal transmission of datas has been perform using the configurations in the display.

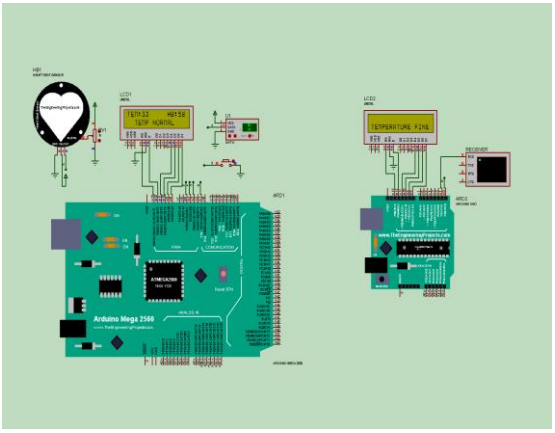


Fig.no.1.4

These sensors collect data on the person's vital signs, which are then transmitted through the water using an underwater communication module. Additionally, a GPS

module is interfaced with the transmitter module to determine the person's exact location.The Receiver Module is equipped with an underwater receiver module to capture the data transmitted through the water. It receives the vital sign data from the transmitter module and displays it on a Liquid Crystal Display (LCD) using the I2C communication protocol

PROGRAMMING

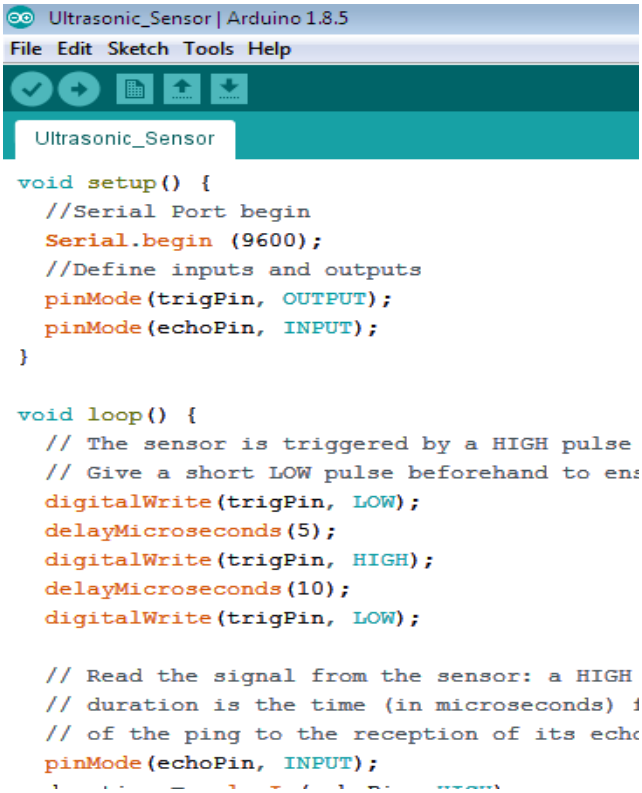


Fig.no.1.5

The Arduino Uno can be programmed with the (Arduino Software (IDE)). Select "Arduino/Genuino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes preprogrammed with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

IV. CONCLUSION

In this paper, we have proposed the architecture of the universal multimode modem, UniSDM. This modem allows joint and seamless operation of acoustic, optical, magnetic induction and RF modes. Furthermore, the implementation of various technologies at the same time is possible, due to the modem software-defined architecture. We provide details for the UniSDM operation and discuss efficient multi-mode cooperation.

In comparison with traditional setups with separate modems, the UniSDM improves synchronization and transmission rate, and reduces latency, all at reduced transceiver cost and size. Compared to our previous conference paper [1], in this work we introduced an algorithm for the modes' cooperative use. We also added a discussion of the modes' features, showing their strong and weak sides and how they complement each other. We estimated the potential UniSDM performance by doing a numerical evaluation. In addition to a comparison of pure acoustic and dual-mode acoustic and optical configurations, we evaluated the configurations with the magnetic induction mode into consideration. We also added a square area scenario with random nodes' location, which showed the results similar to a chain topology.

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