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Emulation of Underwater Acoustic Communication Systems

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Abstract— Underwater acoustic communication plays an important role in underwater wireless sensor network. Different from terrestrial radio channel, modelling of underwater acoustic channel is very challenging due to its unique and dynamic characteristics. In order to verify the proposed acoustic communication algorithms, a general emulation platform which can reduce the verification cost has a wide application prospect. 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 agent'sconcentration. By having a separate TX and RX module in the water between the modules we can transmit the sea researcher's biomedical conditions and interactions to the monitoring end available on the ship.

Keywords— Underwater data Communication, Water precisely. RX module etc

I. INTRODUCTION

Optical communication is a potential technology to realizelong-distance high-speed underwater wireless communication.Facing the difficulty of alignment caused by uncertainty of theposition of transmitter and receiver, poor mechanical stabilityas well as complexity of water environment, the transmissioncharacteristics of underwater optical communication (UOC)signals under alignment conditions are difficult to obtain in thenatural seawater environment. The experiments of long-distanceUOC in the real marine environment are difficult, thatis why there are fewer such attempts [1]. At present, the relatedresearch mainly focuses on the short-range high-speed opticalcommunication in the laboratory.

In the laboratory, to create experimental environment ofUOC this close to the real seawater, the requirement of hardware is rigorous. In order to make the experimenteffective, it is necessary to ensure a long enough underwateroptical channel. A common method is to use longer pools orpipes [2]. The other approach is to use sets of plane mirrors [3].These ways are accurate and credible for simulating direct lightcommunication channels. To focus on the scattering ofunderwater light beams, different thinking is needed.In addition to the experimental vessel, the scattering andabsorption of light beams in seawater should be simulated. InUOC experiments, artificial particles of very small size,commonly known as scattering agents, are often added to waterto simulate the effects of real sea water on photons.

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Thesescattering agents include: Magnesium Hydroxide (MgOH2),ISO 12103-1, A4-Coarse Test Dust (ATD), and Maaloxantacid. Due to the different micro-components, the opticalcharacteristics of these agents are different.

Compared with terrestrial wireless channel, the underwater acoustic channel, especially the shallow ones, has many unique characteristics, which also brings many challenges to the underwater acoustic communication [4]. The time-space-frequency variation, serious multi-path effects and complex noise of underwater acoustic channel all lead to the instability of underwater acoustic communication. In such a complex environment, it is very challenging to design a intelligent high-performance underwater communication system.

In the past decades, researchers have designed many underwater acoustic modulation and demodulation systems. For example, T. Fu, D. Doonan, C. Utley *et al*. have developed the spread spectrum technology based on Walsh code on the platform of Texas Instruments C6713. Lee Freitag, Matthew grand *et al*. have actually developed a set of underwater acoustic modem with Texas Instruments C6713 as the master chip. The system is configured with four different wavebands, which will activate FH-FSK mode at low communication rate and PSK mode at high speed. Aydinlik have developed and verified a variety of communication algorithms in the physical layer, including QPSK modulation, convolution coding and channel equalization by using Texas Instruments TMS320C6713 DSP. The above modems are all based on the traditional modulation and demodulation technology.

With the increasing demand for high-speed transmission of underwater voice and image, traditional modulation and demodulation technology can no longer adapt to such high-speed information transmission [8]. In recent years, Orthogonal Frequency Division Multiplexing (OFDM) technology has been gradually applied into underwater communication system because it can divide the limited spectrum, improve the spectrum utilization rate, and ensure high-speed data transmission. Hai Yan, Lei Wan, Shengli Zhou *et al.* have developed the underwater acoustic communication system based on SISO-OFDM and MIMO-OFDM on the floating-point TMS320C6713 DSP development kit [9]. Zhou and Tong [8] has developed an underwater acoustic modem based on OFDM modulation in OMAP-L138. The system has a communication distance of 1km and a transmission rate of 4kbps. OFDM-based underwater acoustic communication machine on DSP, which developedcan achieve 25.6kbps Rate robust communication without coding within 80m. E. Demirors and T. Melody developed a kind of underwater acoustic modem on Xilinx Zynq Z-7020 platform. Although the above-mentioned underwater acoustic modem has high transmission speed and good performance, its development is based on high-performance chips such as DSP or FPGA. Developers will take a long time to become familiar with related hardware programming, so the development cycle will be long which is expensive.

At the same time, many university scientific research institutions choose to use MATLAB to simulate the underwater acoustic channel, and verify the communication algorithm based on this channel. The typical one is Bellhop model. The establishment of this model requires the setting of multiple parameters, and the setting of each parameter needs to refer to a large number of parameter measurement literatures in related fields. However, many actual channels' parameter is still affected by the changes of underwater acoustic environment, which is difficult to describe the trend with specific formula; sometimes small changes will cause strong interference to the communication, such as Doppler Effect. Therefore, the channel constructed by software is quite different from the actual channel, and the performance of some new communication algorithms needs to be verified by using the actual channel.

Compared with DSP and FPGA, the underwater acoustic modem developed and DAQmx use graphical programming instead of embedded programming,which shortens the development cycle. Developers can get rid of the complex work of deep understanding of specific chips and focus on the implementation of communication algorithm [12]. At the same time, with the use of graphical programming, the realization of visual interface is relatively simple. It provides great convenience for the verification of new algorithm. Once the algorithm verification is validated, we can port it to DSP or FPGA system. Tao et al. [13] used NI to realize two modulation modes, FH-4FSK and DSSS-DBPSK respectively. The coding communication range is 4000m with, and the BER is on the level of 10−3. However, the transmission rate of this communication system is low, so the implementation of high-speed OFDM communication mechanism is not considered. Chen et al. [14] implemented a relatively complete OFDM modulation system based on Lab VIEW, including channel coding, Doppler estimation, channel estimation and other functions. After the lake test, under the condition of 1km communication distance, the BER can reach the level of 10−3. However, when dealing with a large number of data calculations, using is obviously not enough. MATLAB provides a convenient platform for algorithm verification, and has significant advantages in a large number of data calculations, especially in the Fast Fourier Transformation (FFT, the key step in many modulations and demodulation algorithms) is much faster than any other embedded system libraries. But MATLAB lacks the interface with the hardware, so it can't send the signal generated by itself directly through the transducer. It requires a specific IO interface, while the DAQmx system can only provide common system interface. Therefore, this system uses MATLAB, NI and DAQmx to build a set of modem, which is simple to implement and convenient to debug. It can verify various communication algorithms written by developers on this system.

Marine environments are not easy scenarios for human activities, especially when the operations have to be performed at depths larger than 50 m. underwater research is hampered by the requirement of developing waterproof and weight

compensated devices, protected against high pressure. Despite these limitations, the range of underwater applications continuously increases. Research on archaeology or marine environment, maintenance and inspection of oil and gas infrastructures, and fish farming are some examples of human activities conducted at sea. Technological advances have enabled the automation of some of these activities, and also the cooperation of several devices in order to conduct complex tasks. The rise of the number of devices employed in underwater activities has motivated intense research in the field of underwater wireless networks to interconnect all these devices. A current trend in robotic intervention is focused on cooperative applications with multiple remotely operated vehicles (ROV) or I-AUVs (Autonomous Underwater Vehicles for Intervention). For this, some robots conduct a given task while others perform additional activities, such as visual surveying, to provide the operator with visual feedback of the progress of the operation. The communication between the ROVs or autonomous underwater vehicles (AUV) and the operator is usually based on umbilical cables or acoustic transducers. While these approaches are valid in experiments with a small number of vehicles, the participation of more and more robots in underwater interventions require novel solutions. In general, acoustic communications are a good solution for long range transmissions (>1000 m), but having several robots sharing the same acoustic channel might degrade the performance of the communication link. Therefore, alternative solutions based on radio frequency (RF) [1–3] are also considered for short range communications between ROVs. The problem with RF is the strong attenuation of electromagnetic signals in marine water, which limits the communication range to 15 m [4]. Visual light communication (VLC) [5–7] is another alternative that has a higher range than RF, but requires that the transmitter and the receiver are aligned. The communication link based on VLC is heavily influenced by water turbidity, being hard to operate in dirty water.

II. LITERATURE SERVEY

A. Underwater Wireless Communications for Cooperative Robotics with UWSim-NET

The increasing number of autonomous underwater vehicles (AUVs) cooperating in underwater operations has motivated the use of wireless communications. Their modelling can minimize the impact of their limited performance in real-time robotic interventions. However, robotic frameworks hardly ever consider the communications, and network simulators are not suitable for HIL experiments. In this work, the UWSim-NET is presented, an open source tool to simulate the impact of communications in underwater robotics. It gathers the benefits of NS3 in modelling communication networks with those of the underwater robot simulator (UWSim) and the robot operating system (ROS) in modelling robotic systems. This article also shows the results of three experiments that demonstrate the capabilities of UWSim-NET in modelling radio frequency (RF) and acoustic links in underwater scenarios. It also permits evaluating several MAC protocols such as additive links online Hawaii area (ALOHA), slotted floor acquisition multiple access (S-FAMA) and user defined protocols. A third experiment demonstrated the excellent capabilities of UWSim-NET in conducting hardware in the loop (HIL) experiments

B. Light based underwater wireless communications

Underwater wireless optical communication (UWOC) is a wireless communication technology that uses visible light to transmit data in underwater environment. Compared to radio-frequency (RF) and acoustic underwater techniques, UWOC has many advantages including large information bandwidth, unlicensed spectrum and low power requirements. This review paper provides an overview of the latest UWOC research. Additionally, we present a detailed description of transmitter and receiver technologies which are key components of UWOC systems. Moreover, studies investigating underwater optical channel models for both simple attenuation and the impact of turbulence including air bubbles and inhomogeneous salinity and temperature are also described. Future research challenges are identified and outlined.

C. Visible Light Communication: A System Perspective— Overview and Challenges

Visible light communication (VLC) is a new paradigm that could revolutionise the future of wireless communication. In VLC, information is transmitted through modulating the visible light spectrum (400–700 nm) that is used for illumination. Analytical and experimental work has shown the potential of VLC to provide high-speed data communication with the added advantage of improved energy efficiency and communication security/privacy. VLC is still in the early phase of research. There are fewer review articles published on this topic mostly addressing the physical layer research. Unlike other reviews, this article gives a system perspective of VLC along with the survey on existing literature and potential challenges toward the implementation and integration of VLC.

D. Optical Data Transfer in Underwater System using Lifi

We present wireless optical communication system for data transfer in the underwater networks. We use the optical channel to facilitate the communication link in free space and under water. This work bypasses the limitations involved in the use of electromagnetic waves and acoustics for free space and underwater communication. The system shows that optical communication using light can be a good solution for underwater data transmission applications that requires high data rate at the moderate distances. We have designed, implemented and tested our system in real time and provide the evaluations results. Become an enabling technology that has many prospective employments in a range of environments from the deep sea to coastal waters. This development effort has enhanced infrastructure for scientific research and commercial use by providing technology to efficiently communicate between surface vessels, underwater vehicles and sea floor infrastructure [1]. The restrictions

involved in acoustics such as frequency attenuation disburse its bandwidth. Therefore acoustic tactic cannot attain higher data rates. Optics has been proposed as the best alternative in an attempt to overcome the restrictions involved in acoustics [2]. The need for wireless optical systems is accelerated by several factors. Primarily, more and more bandwidth is required by the end user; which means that more data access must be provided.

E. Real-Time Text Transmission Implemented For Underwater Wireless Communication Using a LED Array

With the integration of smart sensor technology, wireless communications paves way for better and challenging applications like environment monitoring of difficult terrains, gathering of widely varying oceanographic data, search and rescue missions especially under water.Underwater communication is a trending field of interest and approaches are under development for achieving low power consumption, compact size and better range. Use of optical waves for underwater communication is an effective approach for secured communication at faster data transfer rates. The paper deals with the implementation of a Li-Fi based module for underwater communication. The system is designed and implemented on the principle of transmission through LED array and reception using a solar panel. The experimental observations analyze the distance versus power relationship for the transfer of textual data. The data transfer is found to be applicable for underwater communication.

F. *Underwater Optical Wireless Communications, Networking, and Localization: A Survey*

Underwater wireless communications can be carried out through acoustic, radio frequency (RF), and optical waves. Compared to its bandwidth limited acoustic and RF counterparts, underwater optical wireless communications (UOWCs) can support higher data rates at low latency levels. However, severe aquatic channel conditions (e.g., absorption, scattering, turbulence, etc.) pose great challenges for UOWCs and significantly reduce the attainable communication ranges, which necessitate efficient networking and localization solutions. Therefore, we provide a comprehensive survey on the challenges, advances, and prospects of underwater optical wireless networks (UOWNs) from a layer by layer perspective which includes: 1) Potential network architectures; 2) Physical layer issues including propagation characteristics, channel modeling, and modulation techniques 3) Data link layer problems covering link configurations, link budgets, performance metrics, and multiple access schemes; 4) Network layer topics containing relaying techniques and potential routing algorithms; 5) Transport layer subjects such as connectivity, reliability, flow and congestion control; 6) Application layer goals and state-of-the-art UOWN applications, and 7) Localization and its impacts on UOWN layers. Finally, we outline the open research challenges and point out the future directions for underwater optical wireless communications, networking, and localization research.

G.Implementing IoT in Underwater communication using Li-Fi

Internet of Things (IoT) is attracting more research interest as a result of increased interaction of human with underwater world. IoT technology using Light fidelity (Li-Fi) module plays a vital role in Environmental monitoring, underwater exploration, underwater Disaster management and underwater military Applications. In this paper, we implement IoT in underwater communication using Li-Fi module. However Implementing Li-Fi module in underwater pose grand challenges due to the unique features of underwater channel and acoustic systems. We comprehensively investigate these unique features and finally possible solutions are provided. Simulations are done using MATLAB software to find which colour of light emitting diode (LED) is suitable for underwater Communication. It is found that Blue – Cyan-Green Spectral range of wavelength 490nm to 560nm is suitable for underwater communication. We obtain low absorption, scattering and attenuation loss in the Blue – CyanGreen Spectral range. An application was developed for the fisherman to identify number and variety of fishes available in particular location.

1) EXISTING SYSTEM

The establishment of this model requires the setting of multipleparameters, and the setting of each parameter needs torefer to a large number of parameter measurement literatures in related ends. However, many actual channels' parameteris still affected by the changes of underwater acoustic environment, which is difficult to describe the trend with special formula, sometimes small changes will cause stronginterference to the communication, such as Doppler Effect.Therefore, the channel constructed by software is quite differentfrom the actual channel, and the performance of somenew communication algorithms needs to be verified by usingthe actual channel. The transmitter of the system can send real-time modulation signal, and modify the modulation algorithm to meet the requirements of the researchers, which greatly reduces the development time of the researchers. At the same time, we have implemented three kinds of modulation and demodulation algorithms in this system, and proposed a new frame synchronization algorithm based on adaptive threshold and short-time Fourier transform.

DIS ADVANTAGES

- The algorithm can be applied in low computational complexity, and high frame synchronization detection rate.
- However, there are still some deficiencies in this system. At present, the receiver needs to be demodulated offline, lacking in real-time performance.
- Developers can get rid of the complex work of deep understanding of special chips and focus on the implementation of communication algorithm. At the same time, with the use of graphical programming, the realization of visual interface is relatively simple.

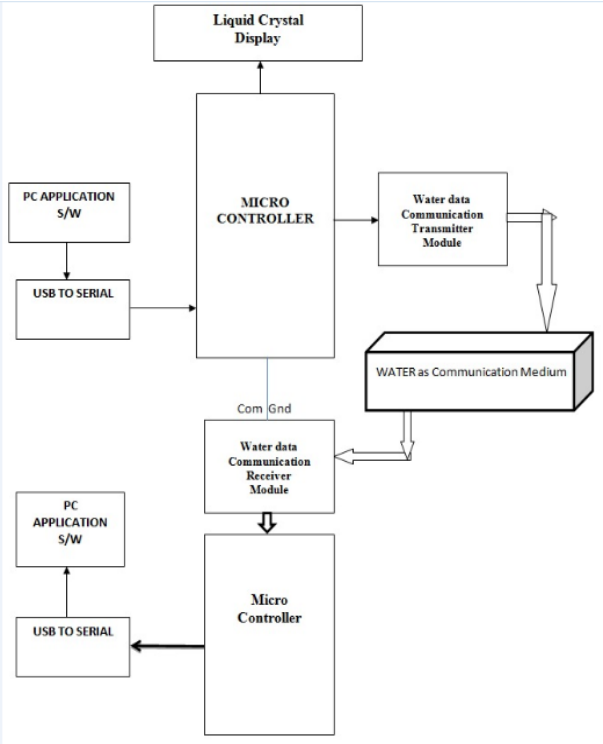
2) PROPOSED SYSTEM

Underwater communication and robot technologies have grown rapidly in the last decade. Systems made of underwater unmanned vehicles have moved from single vehicle deployments to systems comprising teams of assets. As of today the possibility to support cooperation and interoperability of heterogeneous platforms is a key issue. The transmitter of the system can send real-timemodulation signal, and modify the modulation algorithmto meet the requirements of the researchers, which greatly reduces the development time of the researchers. At the sametime, we have implemented three kinds of modulation anddemodulation algorithms in this system, and proposed a newframe synchronization algorithm based on adaptive thresholdand short-time Fourier transform. The algorithm can beapplied in low computational complexity, and high framesynchronization detection rate.

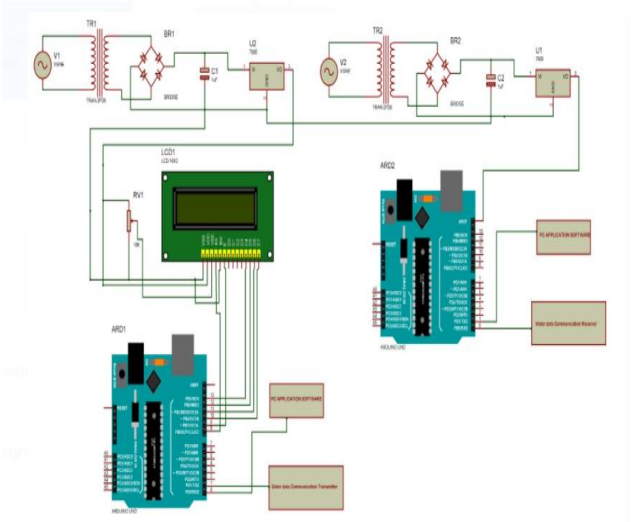
ADVANTAGES

- Tests at sea are not appropriate for experimentation during the assembly and evaluation stages because of the high number of devices involved. Spatial limitations in the laboratory also complicate the evaluation of the complete system.
- Hardware-in-the-Loop (HIL) experiments take a key role during the experimentation, since they permit evaluating some of the hardware devices while the remaining devices are modeled by software.

III. BLOCK DIAGRAM



CIRCUIT DIAGRAM



A. IMPLEMENTATION PLATFORM

HARDWARE REQUIREMENTS

- Power supply unit
- Ardiuno Uno
- Water data communication
- USB to serial
- LCD display

IV. POWER SUPPLY UNIT

Electrical power is the rate of movement of electrons that create energy. As a result of the electronic age many products need electrical power to perform certain activities. Being able to manipulate electrical power comes at a cost. In today's world there is always the bottom line, cost. Power supplies are the devices that can manipulate electrical power to be used in various applications. Power supplies can be expensive but there are cheaper alternative solutions that can produce the same output. A power supply includes conversion steps and has to be reliable enough not to damage what it is hooked up to. Both aspects need specific parts in a certain orientations to create those specific outputs.

A. Design of Power Supply (12V & 5V Combo power supply)

Everycircuitrunsonadifferentvoltage,somecircuits'runson 5V,9Vandsoon.But in this project we will be using 5V and 12V ifweareusinganATMEGA16bitmicrocontrol thenweneeda5VpowersupplybecausetheoperatingvoltageforA TMEGA16microcontrol is5V.Ifyouwillgivevoltagegreaterthan5Vthanyourmicrocontrol lermaygetdamaged.

Foravoidingthiswealwaysusea5Vpowersupplyformicrocontrollercircuits.

Belowisablockdiagramofdcpowersupplyinwhichfourstepsaregivennamedas:-

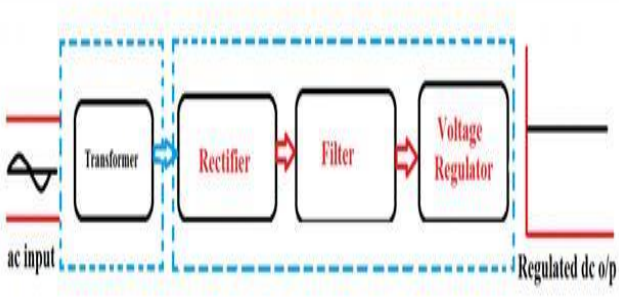


Fig 4.1: Block Diagram of Power Supply

1.Transformer(SteppingDown)
2.Rectifier(actodcconversion)
3. Filter(Removingripplesfromdccurrent)
4.VoltageRegulator(Tosetregulateddcsupply)

Steppingdownvoltage:-

Firststepisscaledownthevoltagebyastepdowntransformer. Stepdowntransformerconvertsthe230 ACvoltagestothelowerACvoltage.Maximumpeoplethinkthatatransformergivedcoutputvoltagebecausewedo notgetshockby touching its outputwire. But this is totally wrong. A stepdown transformer gives (alternatingcurrent)atoutput

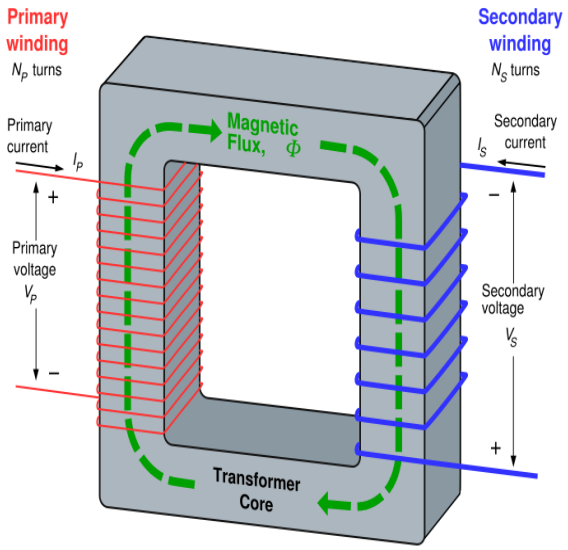


Fig 4.2 Transformer

Mathematically:

$$\frac{N_S}{N_p} = \frac{E_S}{E_P}, \quad N_s = N_p x \frac{E_S}{E_P}$$

And for current, *I*

$$\frac{I_P}{I_S} = \frac{N_S}{N_p} = \frac{E_S}{E_P}$$

Where, N_s = Secondary Turns
N_p = Primary Turns
E_s = Secondary Voltage
E_p = Primary Voltage
I_s = Secondary Current
I_p = Primary Current

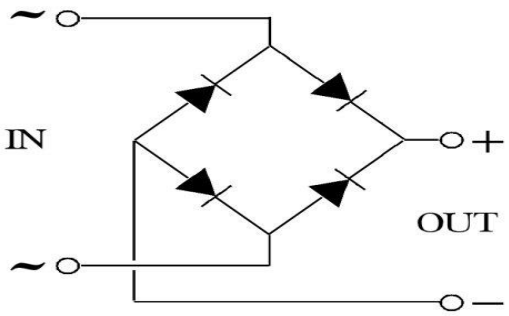


Fig 4.3 Full Bridge Rectify Connection

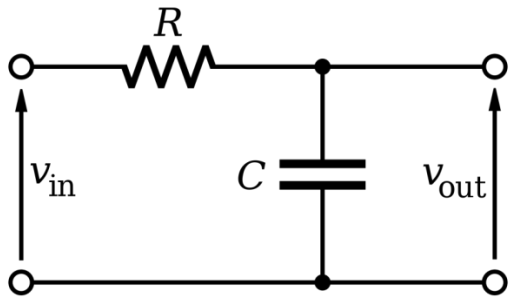


Fig 4.4: Capacitor filtering connection

Description:

This is a simple approach to obtain a 12V and 5V DC power supply using a single circuit. The circuit uses two ICs 7812(IC1) and 7805 (IC2) for obtaining the required voltages. The AC mains voltage will be stepped down by the transformer T1, rectified by bridge B1 and filtered by capacitor C1 to obtain a steady DC level. The IC1 regulates this voltage to obtain a steady 12V DC. The output of the IC1 will be regulated by the IC2 to obtain a steady 5V DC at its output. In this way both 12V and 5V DC are obtained. Such a circuit is very useful in cases when we need two DC voltages for the operation of a circuit. By varying the type number of the IC1 and IC2, various combinations of output voltages can be obtained. If 7806 is used for IC2, we will get 6V instead of 5V.Same way if 7809 is used for IC1 we get 9V instead of 12V.

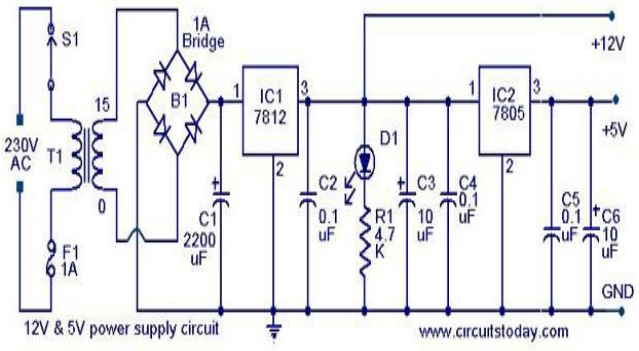


Fig 3.2.8: Power Supply Circuit Diagram

Notes:

- Assemble the circuit on a good quality PCB or common board.
- The transformer T1 can be a 230V primary, 15V secondary, 1A step-down transformer.
- The fuse F1 can be of 1A.
- The switch S1 can be a SPST ON/OFF switch.
- The LED D1 acts as a power ON indicator.
- If 1A bridge B1 is not available, make one using four 1N4007 diodes.
- 78XX series ICs can deliver only up to 1A output current.

V.**ARDUINO**

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform, for a comparison with previous versions.

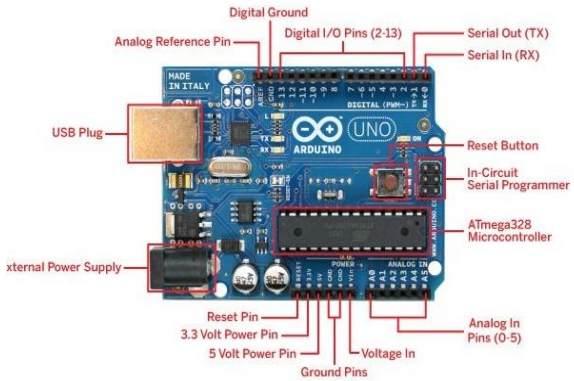


Figure5.1 Arduino Board

A. Arduino Architecture

Arduino's processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory.The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the boot loader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz. The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware programmer to burn the program. This is done because of the presence of the 0.5KB of Boot loader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code.

5.1.2 Arduino ATMega328 Pin Description

ATMega328 is a 28 pin chip as shown in pin diagram above. Many pins of the chip here have more than one function. We will describe functions of each pin below.

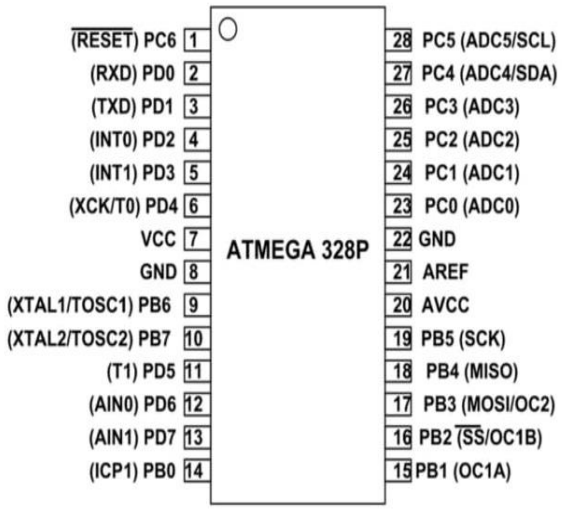


Figure 5.2 Arduino ATMega328

1. VCC

Digital Supply Voltage.

2.GND

Ground.

3.Port B (PB[7:0]) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB[7:6] is used as TOSC[2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

4.Port C (PC[5:0])

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors(selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

5.PC6/RESET

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is un-programmed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset. The various special features of Port Care elaborated in the Alternate Functions of Port C section.

6.Port D (PD[7:0])

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

7.AVCC

AVCC is the supply voltage pin for the A/D Converter, PC[3:0], and PE[3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC[6:4] use digital supply voltage, VCC.

8.AREF

AREF is the Analog reference pin for the A/D Converter.

9.ADC[7:6] (TQFP and VFQFN Package Only)

In the TQFP and VFQFN package, ADC[7:6] serve as Analog inputs to the A/D converter. These pins arepowered from the Analog supply and serve as10-bit ADC channels.

1.1.3 Features of Arduino UNO

Microcontroller –Atmega328P – 8 bit AVR family microcontroller.

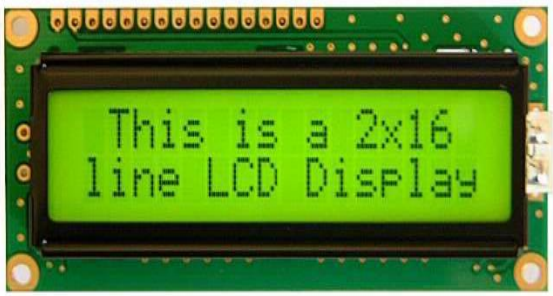
- Operating Voltage – 5V
- Analog Input Pins – 6 (A0 – A5)
- Digital I/O Pins – 14 pins
- Flash Memory – 32 KB (0.5 KB is used for Boot loader)

SRAM – 2 KB

VI. LIQUID CRYSTAL DISPLAY

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle. One each polarizer's are pasted outside the two glass panels. These polarizer's would rotate the light rays passing through them to a definite angle, in a particular direction When the LCD is in the off state, light rays are rotated by the two polarizer's and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer's, which would result in activating / highlighting the desired characters. The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCD's doing generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly. The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.



Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0

8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

USB to serial

CP2102 chip is a single chip USB to UART Bridge IC. It requires minimal external components. CP2102 can be used to mi-grate legacy serial port based devices to USB.

Features:-

Stable and reliable chipset CP2102.

USB specification 2.0 compliant with full-speed 12Mbps.

Standard USB type A male and TTL 6pin connector.

6pins for 3.3V, RST, TXD, RXD, GND & 5V.

Baud rates: 300 bps to 1.5 Mbps

Byte receive buffer; 640 byte transmit buffer.

Hardware or X-On/X-Off handshaking supported.

Event character support Line break transmission.

USB suspend states supported via SUSPEND pins.

Temperature Range: -40 to +85.

Size: 42mm X 15mm.

Weight: 4g

Pinouts:-

TX = Connect to Transmit Pin(TXD) of Micro controller. This pin is RX pin of CP2102 on board.

RX = Connect to Receive Pin(RXD) of Micro controller. This pin is TX pin of CP2102 on board.

RST = Normally Unconnected. Reset Pin for CP2102. Initiate a system reset by driving this pin low for at least 15 µs.

GND = should be common to microcontroller ground.

3V3 = Optional output to power external circuit up to 50mA.

5V = Optional output to power external circuit up to 100mA

VII. PROJECT DESCRIPTION

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system.

The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

2.It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily.

2. Select methods for presenting information.

3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- Convey information about past activities, current status or projections of theFuture.

- Signal important events, opportunities, problems, or warnings.
- Trigger an action.
- Confirm an action.

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out.

This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

A. ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited.

The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

B. TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources.

This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

C. SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently.

The user must not feel threatened by the system, instead must accept it as a necessity.

The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it.

VIII. SYSTEM IMPLEMENTATION

The interest in Underwater Wireless Networks (UWNs) has largely increased in the past decade to support a wide range of emerging applications, including monitoring of the environment and critical infrastructure, coastline protection, and prediction of underwater seismic and volcanic events [2], [3]. To support these applications the technology of Unmanned Maritime Vehicles (UMVs) has evolved significantly in the past five years. Autonomous Underwater Vehicles (AUVs), Unmanned Surface Vehicles (USVs), Remotely Operated Vehicles (ROVs), gliders, buoys, vessels, and fixed subsea or surface equipment are increasingly working together [4], [5]. New types of UMVs have been developed by both Research Institutions and Industry with increasing capabilities. As stated in [4], however, the status of technology and user maturity needs to be differentiated between what is being done in research and what is being employed operationally. For instance, cooperative control of many UMVs has been researched and experimented for more than a decade. However, UMVs working together autonomously in an operational/commercial setting is yet to be realized. One of the main reasons for this reduced speed in the development and deployment of UWNs is the absence of standards and common interfaces for underwater digital communication and information sharing among heterogeneous network nodes. A first initiative to define a common language to support initial contact and emergency message exchange between nodes has been initiated by the NATO STO Centre for Maritime Research and Experimentation (CMRE) together with Academia and Industry. The proposed physical coding scheme, named JANUS [6], [7], [8], [9], is currently in the process of becoming a NATO standard. However, even if the heterogeneous mobile nodes in the network support a common physical coding scheme, they need to encode and decode messages in the same way. Without this level of understanding any interaction between two underwater robots, using different control software, would therefore not be possible.

Mediterranean sea, off the coast of Marzamemi (Sicily, south of Italy), during an archaeological survey mission part of a collaboration between University of Rome “La Sapienza”, University of Porto and the Sicily Region Authority for the Sea. In June 2015 we deployed at sea in Marzamemi the SUNRISE re-deployable testing facility. The SUNRISE re-deployable testing facility is a cable-less tested developed by the University of Rome “La Sapienza” composed by multiple underwater sensor nodes that can be easily deployed and recovered by SUNRISE users. The SUNRISE re-deployable testing facility has been designed to be dynamic, easy to deploy and use and highly adaptable to different application scenarios. Each node of the tested can be easily customized with additional hardware (e.g., sensor(s), battery pack(s), modem(s), external storage drives) based to the user’s needs. Nodes of the SUNRISE re-deployable testing facility run La Sapienza S-SDCS creating a network among each other and with possible multivendor vehicles integrated in the system. In Marzamemi in addition to 4 underwater sensor nodes the re-deployable testing facility included also three Light AUVs which were also running the S-SDCS. In sea trials all the remote commands were correctly delivered to the vehicles using acoustic communications and networking capabilities provided by the S-SDCS, thus resulting in a complete success.

IX. CONCLUSION

In this paper, we propose a general underwater acoustic

modulation and demodulation system. The system has strong compatibility and can be used as an algorithm verification platform to facilitate the algorithm verification of researchers. The transmitter of the system can send real-time modulation signal, and modify the modulation algorithm to meet the requirements of the researchers, which greatly reduces the development time of the researchers. At the same time, we have implemented three kinds of modulation and demodulation algorithms in this system, and proposed a new frame synchronization algorithm based on adaptive threshold and short-time Fourier transform. Communication is a potential technology torealize underwater wireless communication. The experiment ofunderwater optical communication in the laboratory is differentwith that in the real water environment because the physicalscale is limited. Although since recent several decades, artificialscattering agents are used to recreate underwater opticalcommunication channels under different water qualityconditions, but the similarity between experimental water andnatural water is not reliable, such as the similarity in frequencydomain characteristics. In this paper, several kinds of agents areevaluated to change the optical coefficients of experimental waterprecisely. Then, seemed as criterion for the reliability of water recreation, the frequency domain characteristic of opticalcommunication channel in experimental water is measured andcompared. The results show that the type and particle size of theagents will significantly affect its optical properties, and thefrequency domain component of the optical communicationsignal will be affected by the agent's concentration.

X.REFFERENCE

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