VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA, BELAGAVI-590018, KARNATAKA

A Project Report

on

INFRARED WIRELESS UNDERWATER COMMUNICATION SYSTEM

Submitted in partial fulfillment of the requirements for the VIII Semester of degree of ***Bachelor of Engineering in Information Science and Engineering*** *of Visvesvaraya Technological University, Belagavi*

Submitted by

PAVAN H P	**1VI18IS066**
SANJAY H C	**1VI18IS093**
SHREYANK B REDDY	**1VI18IS097**
SHYLESH PALKAR R	**1VI18IS099**

Under the Guidance of

Mr. Manoj Kumar H
Assistant Professor

Department of Information Science and Engineering

VEMANA INSTITUTE OF TECHNOLOGY

BENGALURU – 560 034

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Karnataka ReddyJana Sangha®

VEMANA INSTITUTE OF TECHNOLOGY

Koramangala, Bengaluru-34.

(Affiliated to Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project work entitled "Infrared Wireless Underwater Communication System" is a bonafide work carried out jointly by **PAVAN H P (1VI18IS066), SANJAY H C (1VI18IS093), SHREYANK B REDDY (1VI18IS097) and SHYLESH PALKAR R (1VI18IS099)** in partial fulfillment of the award of **Bachelor of Engineering in Information Science and Engineering** of the Visvesvaraya Technological University, Belagavi during the academic year 2021-22. It is certified that all corrections / suggestions indicated for internal assessment have been incorporated in the report. The project report has been approved as it satisfies the academic requirements in respect of the project work prescribed for the said degree.

Mr. Manoj Kumar H	**Mr. Rajanna. M**	**Dr. Vijayasimha Reddy. B. G**
Guide	Professor and HOD	Principal
Department of ISE	Department of ISE	

External Viva

Name of the Examiners	**Signature with date**
1. ______________________________	______________________________
2. ______________________________	______________________________

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We sincerely thank **Visvesvaraya Technological University** for providing a platform to do our final year project work.

Firstly, we would like to express our deep sense of gratitude to our institute "**Vemana Institute of Technology**" that provided us an opportunity to do a project entitled "**INFRARED WIRELESS UNDERWATER COMMUNICATION SYSTEM**".

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PAVAN H P (1VI18IS066)

SANJAY H C (1VI18IS093)

SHREYANK B REDDY (1VI18IS097)

SHYLESH PALKAR R (1VI18IS099)

DECLARATION

We, **PAVAN H P (1VI18IS066), SANJAY H C (1VI18IS093), SHREYANK B REDDY (1VI18IS097) and SHYLESH PALKAR R (1VI18IS099)** students of VIII Semester BE, in Information Science and Engineering, Vemana Institute of Technology hereby declare that the Project work entitled **"Infrared Wireless Underwater Communication System**" has been carried out by us and submitted in partial fulfillment of the requirements for the *VIII Semester degree of Bachelor of Engineering in Information Science and Engineering of Visvesvaraya Technological University, Belgaum* during academic year 2021-2022.

Place : Bengaluru

Date : 11/07/2022

PAVAN H P	(1VI18IS066)
SANJAY H C	(1VI18IS093)
SHREYANK B REDDY	(1VI18IS097)
SHYLESH PALKAR R	(1VI18IS099)

ABSTRACT

The Wireless communication has been booming in the recent years. However, not much has been done to accomplish communication in water in a wireless manner which can be useful in many scenarios. Most of the communication modes that are existing as of now are either not reliable or are very expensive. IR rays can pass through water and thus be used in case of line of sight for communication purpose in this medium. This IR communication using Keyboard uses two units both controlled by ATmega family microcontroller. Both of the units have IR trans-receivers as communicating agents. Keyboards are needed to be connected on both the ends to enter input to the system. The communication messages get displayed on the LCD connected to the system. The system communicates with confirmation key that is sent back by receiving unit to the sending unit. In this way wireless communication is implemented with great efficiency within a line of sight range of about 3-4 meters under the water with the help of IR wireless underwater Communication project.

Keywords: Liquid crystal display, Acknowledgement, Under water, Wireless communication, Infrared light, Thin small outline package.

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ABBREVIATIONS

LCD	Liquid crystal display
ACK	Acknowledgement
UOWC	Under water wireless communication.
AUV	Autonomous underwater vehicle
FSO	Free space optical communication
IDE	Integrated development environment
IR LED	Infrared Light emitting diode

Chapter 1

INTRODUCTION

IR based underwater communication system that can be used for wireless communication of messages even through water. The system can prove to be a very cheap alternative to long heavy physical wires that run through seas, rivers and require large costs for laying those wires and their maintenance. Our system makes use of infrared transmitter receiver in order to achieve this system. Our system consists of two microcontroller-based circuits that have IR transmitter-receiver pairs as well as LCD displays for displaying the messages. Each system has a keyboard connected to it in order to type in messages. We use two water barrels in order to demonstrate underwater communication using signals passing through those containers. The system also has an acknowledgement receipt message that is sent back from the receiving circuit to the transmitting circuit on message receipt. This allows for efficient communication between two circuits wirelessly.

Wireless communication has been booming in the recent years. However, not much has been done to accomplish communication in water in a wireless manner which can be useful in many scenarios. Most of the communication modes that are existing as of now are either not reliable or are very expensive. IR rays can pass through water and thus can be used in case of line of sight for communication purpose in this medium. IR Communication using Keyboard uses two units both controlled by ATmega family microcontroller. Both of the units have IR Trans-receivers as communicating agents. Keyboards are needed to be connected on both the ends to enter input to the system. The communication messages get displayed on the LCD connected to the system. The system communicates with confirmation key that is sent back by the receiving unit to the sending unit. In this way wireless communication is implemented with great efficiency within a line-of-sight range of about 3-4 meters under the water with the help of IR Communication using Keyboard project.

1.1 Objective

The main considerations in the present field technologies are wireless communications that to underwater which is based on its cost effectiveness. Automation is intended to reduce man wireless communication helps in reducing the burden of long cables that has been in use for the past decade. Due to this we can transmit and receive messages through underwater which will be helpful for military operations, linking submarines to land, using AUV effectively etc. The system is designed to be used for secret code transmissions needed in military, government or other sensitive communications. User may type his message through a computer keyboard. This is then processed by an Atmega328 microcontroller and delivered to the receiver

1.2 Plan of action

Generally, wireless communication system is a concept which uses an IR radiation signals to transmit and receive the messages through underwater without the help of cables. The entire process mainly consists of IR sensor, MC, KEYBOARDS to transfer the messages it also contains an ACK receipt which will be send back from the receiving circuit to the transmitting circuit by saying that the message is received. Our goal is to provide some added information to our next generations based on underwater communication using IR sensor. This system needs monitoring to get secret messages through water which helps in submarines and navy ships etc…

CHAPTER 2

ANALYSIS

2.1 Literature Survey

The literature survey is a review on existing research that is significant to the work that we are carrying out. It helps to develop a good understanding and insights into relevant previous research and its trends and drawbacks that have emerged.The literature review allows the reader to be updated with the state of research in a field and any contradictions that may exist with challenges findings of other research studies. It helps to develop research investigative tools & to improve research methodologies. It also provides the knowledge about the problems faced by the previous researchers while studying same topic. It is the most important part as it gives direction in the area of research of our and it helps us to set a goal for analysis.

[1] Cox, William C.; Simpson, Jim A.; Muth, John F. (2011). [IEEE MILCOM 2011 - 2011 IEEE Military Communications Conference - Baltimore, MD, USA (2011.11.7-2011.11.10)] 2011 - MILCOM 2011 Military Communications Conference - Underwater optical communication using software defined radio over LED and laser based links. , (0), 2057–2062.

Authors: William C. Cox, Jim A. Simpson, and John F. Muth.

Abstract

Underwater optical communication is an attractive means to achieve high data rate, low latency, and covert communication between underwater vehicles or sensor nodes. We demonstrate the viability of using a software defined radio system to communicate at Mbps rates using LEDs and lasers underwater and examine the performance of BPSK and GMSK simplex and duplex links.

Key Analysis

Underwater communication between mobile ocean systems is of great interest to the scientific and military communities. The limited propagation distance of RF frequencies [1] and low datarate of acoustic communication leave optical communication as a viable alternative for low-latency, high datarate communication in our oceans. By taking advantage of the “blue green” optical window in ocean water, underwater optical communication systems can utilize low cost optical sources, like diode lasers.

[2] or LEDs and detectors like PIN photodiodes and PMTs. In this paper we show that software defined radio provides a convenient way to utilize a variety of modulation and demodulation schemes to fully implement an underwater optical communication system.

Conclusion

Underwater optical communication provides the potential for underwater observation to be increased, by allowing underwater vehicles and sensor nodes to gather and transmit larger amounts of data than they are currently able using acoustic communication. The high data rates and low latency make it feasible to establish network connections between these systems for retrieving or downloading large datasets. While many engineering challenges remain, such as how to acquire a link in a timely manner and maintain pointing and tracking, we have demonstrated two types of links using LEDs or lasers that enable network connectivity using a minimum amount of off-the-shelf hardware.

[2] “Underwater Wireless Communication System” - written by Amala Susan Roy , Christymol Bousally, Elizabeth P T published on 2020/10/02.

Authors: Amala Susan Roy, Christymol Bousally, Elizabeth P T.

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. In this paper, 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’s concentration. By having a separate transmitter and receiver 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. The atmospheric conditions under the sea will be changing tremendously. It affects the sea navigators in too much trouble. It is difficult to monitor the health conditions of sea navigator after diving. Even if he dives below 20 meters his heart beat becomes uncontrollably changing. So even if his blood pressure lows dangerously it may leads to death. And there is no idea to save those navigators in those conditions. So here we propose a system to monitor heath conditions of a sea navigator while checking the heart beat reading while navigation. Using a communication system we can monitor a diving navigators heart beat even in ground. If we found his BP is lower in we can say him to enter the ground. So we can save the life of too many navigators.

Key Analysis

Underwater optical wireless communications (UOWC) have gained a considerable interest during the last years as an alternative means for broadband inexpensive submarine communications. UOWC present numerous similarities compared to free space optical (FSO)communications or laser satellite links mainly due to the fact that they employ optical wavelengths to transfer secure information between dedicated point-to-point links. By using suitable wavelengths, high data rates can be attained. Some recent works showed that broadband links can be achieved over moderate ranges. Transmissions of several Mbps have been realized in laboratory experiments by employing a simulated aquatic medium with scattering characteristics similar to oceanic waters.

Conclusion

An improvement in submerged correspondence framework is required because of expanded number of automated vehicles in space and submerged. Conventional submerged correspondence depends on acoustic signs and notwithstanding the generous progression in this field, acoustic correspondence is unable to give adequate data transmission low inertness. Optical submerged correspondence gives incredible potential to enlarge customary acoustic correspondence because of its high information rates, low dormancy, less force utilization and littler bundling. Likewise, this innovation can profit definitively from the advancement made in the earthly optical remote correspondence. We propose another strategy by adding heartbeats to the FDM technique which is predominantly utilized in submerged wire-less information correspondence. Rather than the regular optical remote transmission, we use information correspondence module.

[3] Zhang, L., H. Wang and X. Shao, "Improved m-QAM-OFDM transmission for underwater wireless optical communications". Optics Communications, vol. 423: pp. 180-185, 2018.

Authors: Zhang, L., H. Wang and X. Shao.

Abstract

In this paper, a novel OFDM symbol frame structure was proposed to improve the performance of underwater wireless optical communication (UWOC) systems with m-QAM-OFDM modulation. In the frame, the datacarrying OFDM symbol and corresponding phase-conjugated symbol was interleaved. At the receiver end, by simple superposition of received symbols, the noise suppression can be achieved. The feasibility was experimentally demonstrated by transmitting m-QAM-OFDM signal over a 12.5-m tap water channel and a 1.25-m highly scattering medium which composed of tap water and skimmed milk. The results show that BER performance can be significantly improved in both clear water channel and turbid water channel. Moreover, the proposed frame structure can provide a robust and simple path to compromise between transmission capacity and distance.

Key Analysis

In recent years, ocean exploration has attracted more and more attention due to its economic, strategic and scientific importance. As the rapid development of underwater exploration, traditional acoustic communication and radio-frequency communication cannot meet the needs due to the low modulation bandwidth of acoustic wave and high power attenuation of radio wave in water environment [1,2]. For communication scenarios with short and moderate distances, there is a growing need for high data-rate and reliable underwater wireless optical communication (UWOC) systems, which is expected to provide high data-rates to transmit large data capacity for versatile applications such as underwater oil pipe inspection, remotely operated vehicle (ROV) and sensor networks [3,4]. To meet these needs, UWOC system using visible light emitting diodes (LEDs) or laser diode (LD) has attracted much attention in recent years [5–8]. Many researchers primarily focused on long-range or high-speed transmission, like in [9], a 16 Gb/s fourlevel pulse amplitude modulation (PAM4) UWOC system based on 488-nm LD was experimentally demonstrated over a 10-m distance. Yifei Chen et al. [10] reported a 26-m 5.5 Gbps air–water optical wireless communication based on 520-nm laser diode. In [11], a 20- m UWOC link with 1.5 Gbps data rate was proposed. And to increase system capacity, Yongxiong Ren et al. [12,13] employed orbital angular momentum based space division multiplexing in UWOC.

Among the reported works, because of the high spectral efficiency and simple single-tap equalization, m-QAM-OFDM scheme was experimentally investigated by lots of researchers [14–17]. Lately, Meiwei Kong et al. [18] realized 9.51 Gb/s UWOC in a 10-m underwater link using 32-QAMOFDM and wavelength division multiplexing (WDM). Yu-Chieh Chi et al. [18] reported a 6.4-m UWOC with 8.8 Gbps QAM-OFDM encoding.

Conclusion

In this paper, by interleaving the data-carrying OFDM symbols and the corresponding phase-conjugated symbols, a novel OFDM symbol frame structure was proposed to improve the performance of UWOC systems with m-QAM-OFDM modulation. In the frame the m-QAM symbols on the data-carrying OFDM symbols and the corresponding phaseconjugated symbols on adjacent OFDM symbols experienced highly correlated noise, hence, simple superposition was used to cancel the noise, which can significantly improve the BER performance. We experimentally demonstrated the proposed frame structure by transmitting m- QAM-OFDM signal over a 12.5 m tap water link and a highly scattering medium which composed of tap water and skimmed milk. The results showed that BER performance can be significantly improved in both clear water channel and turbid water channel. Our proposed frame structure provides a robust and simple path of compromising between transmission capacity and distance for UWOC.

[4] Hassan M. Oubei, Jose R. Duran, Bilal Janjua, Huai-Yung Wang, Cheng-Ting Tsai, Yu-Cheih Chi, Tien Khee Ng, Hao-Chung Kuo, Jr-Hau He, Mohamed-Slim Alouini, Gong-Ru Lin, Boon S. Ooi, Wireless optical transmission of 450 nm, 3.2 Gbit/s 16- QAM-OFDM signals over 6.6 m underwater channel, in: Conference on Lasers and Electro-Optics, 2016, paper SW1F.1.

Authors: Hassan M. Oubei, Jose R. Duran, Bilal Janjua, Huai-Yung Wang, Cheng-Ting Tsai, Yu-Cheih Chi, Tien Khee Ng, Hao-Chung Kuo, Jr-Hau He, Mohamed-Slim Alouini, Gong-Ru Lin, Boon S. Ooi

Abstract

We experimentally realized a gigabit underwater wireless optical communication system using commercially available 450 nm blue laser diode. By implementing 16-QAM-OFDM modulation, we achieved data rate of 3.2 Gbit/s with a BER of 6.83×10-4 over 6.6 m channel. OCIS codes: (010.4455) Oceanic propagation; (060.2605) Free space optical communication; (060.4510) Optical communications; (140.2020) Diode lasers

Key Analysis

Traditionally, acoustic waves have been used to establish underwater wireless communications [1]. However, the bandwidth of the underwater acoustic channel has become a limiting factor as more and more versatile applications such as underwater oil pipe inspection, remotely operated vehicle (ROV) and sensor networks require large data transmission capacity [2,3]. Among new alternatives, underwater wireless optical communication (UWOC) has become one of the most promising candidates to offer high data rates in underwater communication links over short and moderate distances (< 100 m) [4,5]. By exploiting the low absorption of seawater in blue-green (400-550 nm) region of the visible light window of the electromagnetic spectrum, Nakamura et al. have demonstrated a 1.45 Gbit/s QAM-OFDM data transmission over 4.8 m underwater link using a 405 nm laser diode (LD) [6]. Recently, Oubei et al. have reported 2.3 Gbit/s over 7 m coastal underwater channel using on-off keying [7].

Conclusion

In summary, we have demonstrated a 3.2 Gbit/s UWOC link over 6.6 m distance using a 16-QAM-OFDM modulation scheme. The UWOC system uses a commercially available TO-9 packaged and fiber pigtailed 450 nm LD as transmitter and an APD module as receiver. At 3.2 Gbit/s data rate, the measured error vector magnitude and SNR of the transmitted 16-QAM-OFDM data are 14.34 % and 17.71 dB, respectively. The corresponding BER is 6.83×10- 4 , which is below the FEC threshold of 3.8×10-3 required for error-free operation.

2.2 Existing System

Underwater wireless communications system comprising first and second communications modules which transmit and receive data utilizing infrared radiation. Also known as trance-receiver. In this we see that communication defined does not provides a convenient way to utilize a variety of modulation and demodulation schemes to fully implement an underwater communication system.

2.3 Problem Statement

Underwater communication plays an important role in the exploitation of natural resources but it cannot be accomplished without the burden of heavy cables and the cost will also increase with increase in the area of communication needed.

2.4 Proposed System

IR based underwater communication system that can be used for wireless communication of messages even through water. Underwater communication system consists of two communications modules transmit and receive data utilizing infrared radiation. This system also has an acknowledgement receipt message that is sent back from the receiving circuit to the transmitting circuit on message receipt. This allows for efficient communication between two circuit wirelessly.

CHAPTER 3

SYSTEM REQUIREMENTS

3.1 Hardware Requirements

3.1.1 Power Supply

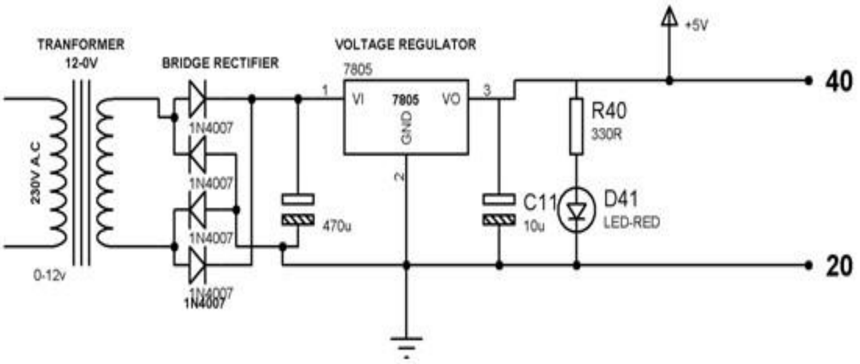

Figure 3.1 Power supply circuit diagram

The 230V AC supply is first stepped down to 12V AC using a step down transformer. This is then converted to DC using bridge rectifier. The AC ripples is filtered out by using a capacitor and given to the input pin of voltage regulator 7805. At output pin of this regulator we get a constant 5V DC which is used for MC and other ICs in this project as shown in figure 3.1.

3.1.2. Transformer

Transformers convert AC electricity from one voltage to another with a little loss of power. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high voltage to a safer low voltage.

Figure 3.2 Transformer

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power as shown in figure 3.2.

The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage. Turns ratio = (Vp / Vs) = (Np / Ns)

Vp = primary (input) voltage.

Vs = secondary (output) voltage

Np = number of turns on primary coil

Ns = number of turns on secondary coil

Ip = primary (input) current

Is = secondary (output) current.

3.1.3. LCD Display

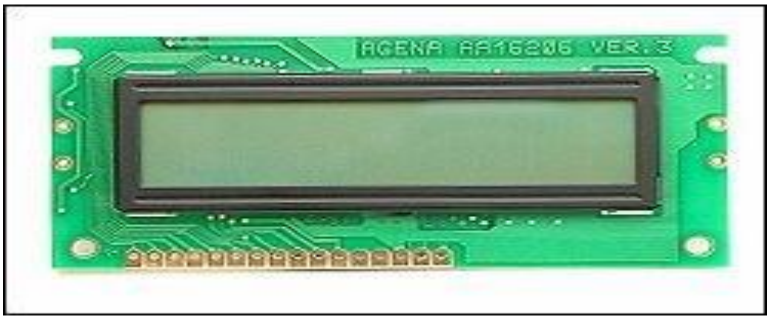

Figure 3.3: LCD display

Most common LCDs connected to the microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source (and communicates directly with the LCD as shown in figure 3.3.

3.1.4. Microcontroller

The Atmel ATmega328P is a 32K 8-bit microcontroller based on the AVR architecture. Many instructions are executed in a single clock cycle providing a throughput of almost 20 MIPS at 20MHz. The ATMEGA328-PU comes in an PDIP 28 pin package and is suitable for use on our 28 pin AVR Development Board as shown in figure 3.4

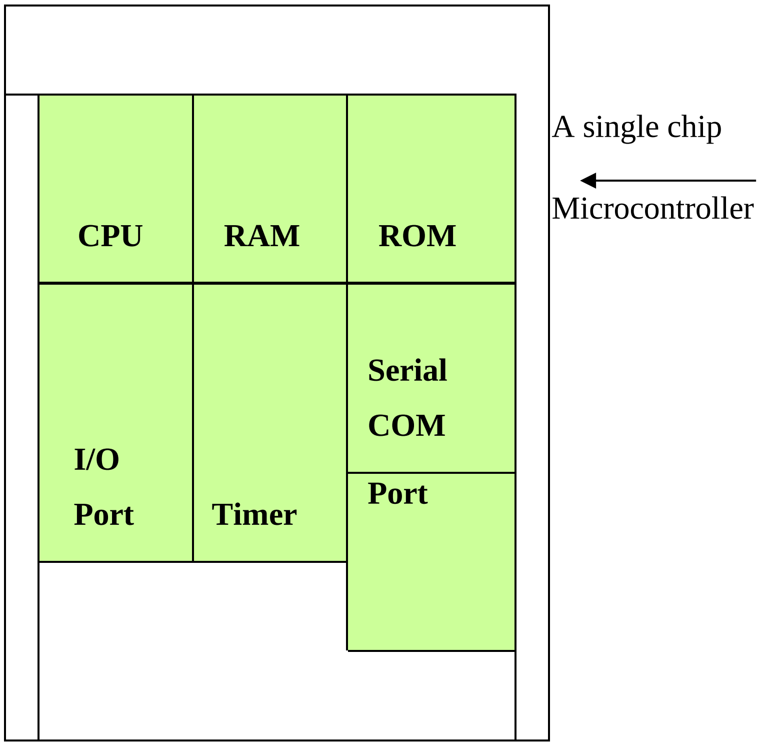

Figure 3.4: Single chip MC

The computer on one hand is designed to perform all the general purpose tasks on a single machine like you can use a computer to run a software to perform calculations or you can use a computer to store some multimedia file or to access internet through the browser, whereas the microcontrollers are meant to perform only the specific tasks, for e.g., switching the AC off automatically when room temperature drops to a certain defined limit and again turning it ON when temperature rises above the defined limit. There are number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform the desired task, most common of these are 8051, AVR and PIC microcontrollers. In this we will introduce you with AVR family of microcontrollers.

Features

a) High Performance, Low Power Design

b) 8-Bit Microcontroller Atmel® AVR® advanced RISC architecture

c) 131 Instructions most of which are executed in a single clock cycle

d) Up to 20 MIPS throughput at 20 MHz

e) 32 x 8 working registers

f) 2 cycle multiplier Memory Includes:

g) 32KB of programmable FLASH

Operating voltage

a) 1.8 - 5.5V

Operating temperature range

a) 40°C to 85°C

Speed Grades

a) 0-4 MHz at 1.8-5.5V

b) 0-10 MHz at 2.7-5.5V

c) 0-20 MHz at 4.5-5.5V

Low power consumption mode at 1.8V, 1 MHz and 25°C

a) Active Mode: 0.3 mA

b) Power-down Mode: 0.1 µA

3.1.5 Block diagram of MC

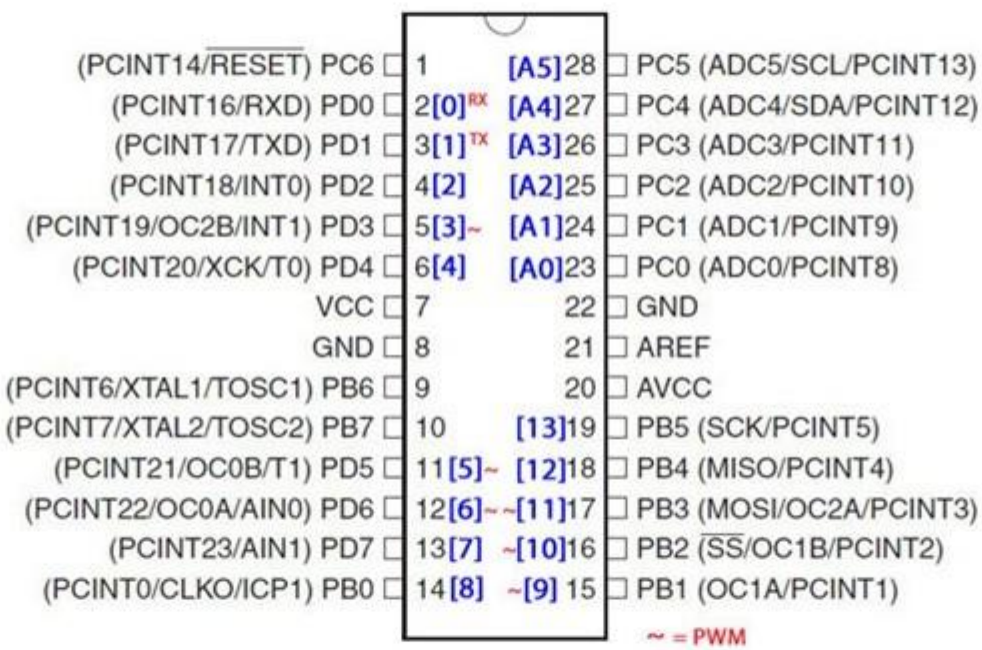

Figure 3.5 Pin configuration of MC

PIN count: Atmega32 has got 40 pins. Two for Power (pin no.10: +5v, pin no. 11: ground), two for oscillator (pin 12, 13), one for reset (pin 9), three for providing necessary power and reference voltage to its internal ADC, and 32 (4×8) I/O pins.

About I/O pins: ATmega32 is capable of handling analogue inputs. Port A can be used as either DIGITAL I/O Lines or each individual pin can be used as a single input channel to the internal ADC of ATmega32, plus a pair of pins AREF, AVCC & GND together can make an ADC channel.No pins can perform and serve for two purposes (for an example: Port A pins cannot work as a Digital I/O pin while the Internal ADC is activated) at the same time. It's the programmer's responsibility to resolve the conflict in the circuitry and the program. Programmers are advised to have a look to the priority tables and the internal configuration from the datasheet as shown in fig 3.5.

Digital I/O pins: ATmega32 has 32 pins (4portsx8pins) configurable as Digital I/O pins.

Timers: 3 Inbuilt timer/counters, two 8 bit (timer0, timer2) and one 16 bit (timer1).

ADC: It has one successive approximation type ADC in which total 8 single channels are selectable. They can also be used as 7 (for TQFP packages) or 2 (for DIP packages) differential channels. Reference is selectable, either an external reference can be used or the internal 2.56V reference can be brought into action. There external reference can be connected to the AREF pin.

Communication Options: ATmega32 has three data transfer modules embedded in it. They are

a) Two Wire Interface

b) USART

c) Serial Peripheral Interface

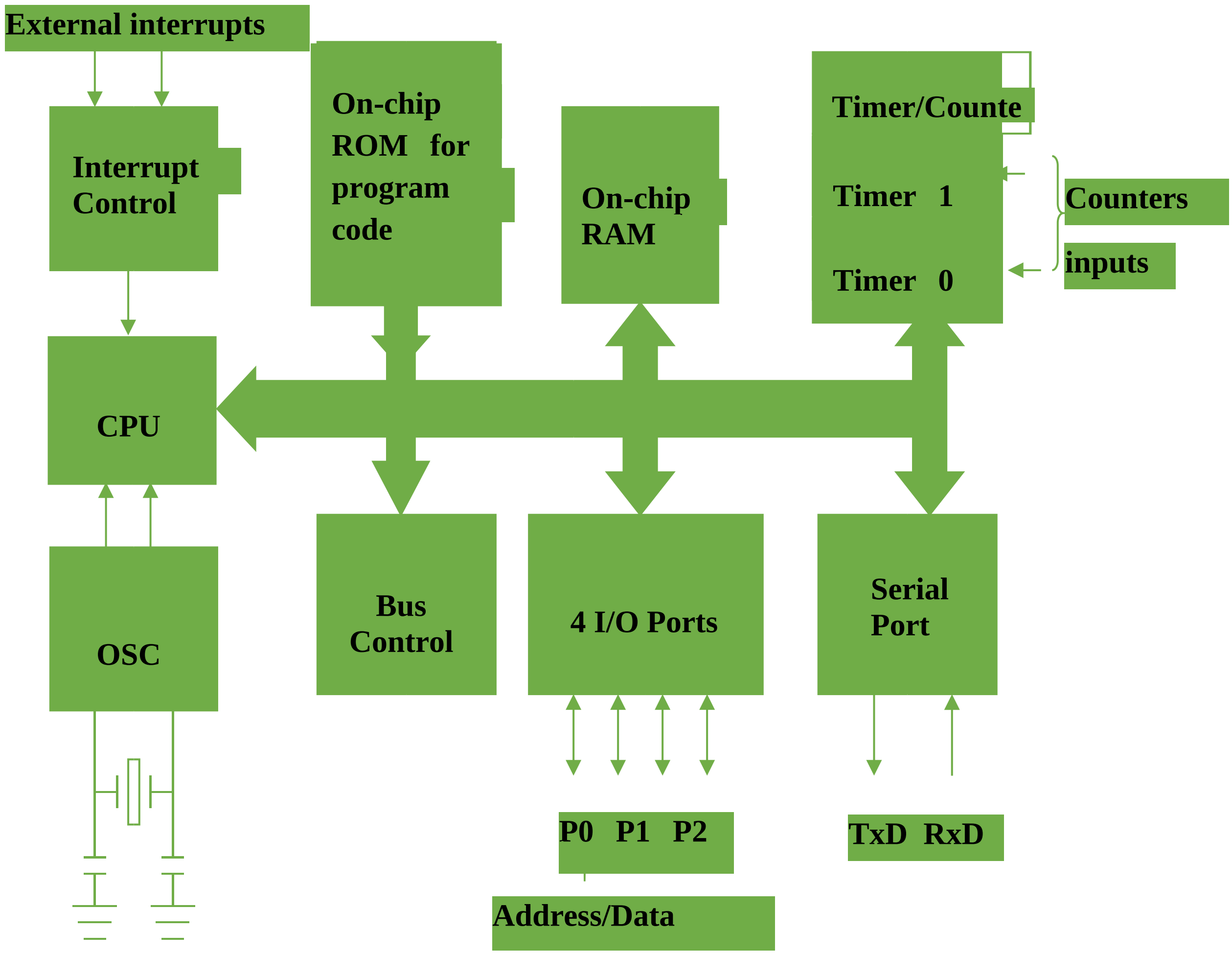

Figure 3.6 Blockdiagram of MC

Analog comparator: On-chip analog comparator is available. An interrupt is assigned for different comparison result obtained from the inputs.

External Interrupt: 3External interrupt is accepted. Interrupt sense is configurable.

Memory: It has 32Kbytes of In-System Self-programmable Flash program memory, 1024 Bytes EEPROM, 2Kbytes Internal SRAM. Write/Erase Cycles: 10,000 Flash / 100,000 EEPROM.

Clock: It can run at a frequency from 1 to 16 MHz. Frequency can be obtained from external Quartz Crystal, Ceramic crystal or an R-C network. Internal calibrated RC oscillator can also be used.

More Features: Up to 16 MIPS throughput at 16MHz. Most of the instruction executes in a single cycle. Two cycle on-chip multiplication. 32 × 8 General Purpose Working Registers as shown in figure 3.6.

Debug: JTAG boundary scan facilitates on chip debug.

3.1.6 IR Led

Figure 3.7: LED

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. They along with IR receivers, are commonly used as sensors as shown in figure 3.7.

Features:

a) Extra high radiant power

b) low forward voltage

c) suitable for high pulse current operation intensity and high reliability.

3.1.7 TSOP

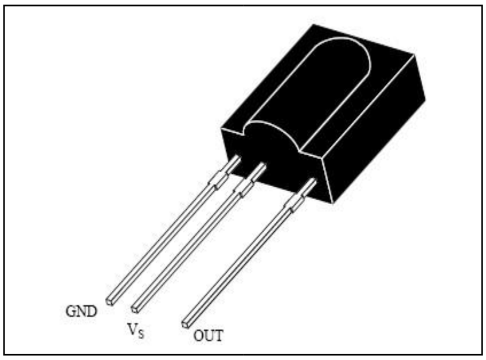

Figure 3.8: TSOP receiver

It’s a standard IR remote control receiver supporting all major transmission codes

Pin1 – Connected to Ground

Pin2 – Connected to Vcc

Pin3 – Output Pin

In Between 1st Pin and 2nd Pin we have to connect one Capacitor

TSOP 1738 Receives 14—bit of data as shown in figure 3.8.

3.1.8 Computer keyboard

Figure 3.9: Keyboard

A computerkeyboard is a typewriter-styledevice which uses an arrangement of buttons or keys to act as mechanical levers or electronic switches. Replacing early punched cards and paper tape technology, interaction via teleprinter-style keyboards have been the main input method for computers since the 1970s, supplemented by the computer mouse since the 1980s. Keyboard keys (buttons) typically have a set of characters engraved or printed on them, and each press of a key typically corresponds to a single written symbol as shown in figure 3.9.

However, producing some symbols may require pressing and holding several keys simultaneously or in sequence. While most keyboard keys produce letters, numbers or symbols (characters), other keys or simultaneous key presses can prompt the computer to execute system commands, such as such as the Control-Alt-Delete combination used with Microsoft Windows. In a modern computer, the interpretation of key presses is generally left to the software: the information sent to the computer, the scan code, tells it only which key (or keys) on which row and column, was pressed or released.

3.1.9 Crystal oscillator

Figure 3.10 Crystal oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including poly crystalline ceramics are used in similar circuits as shown in figure 3.10.

3.1.10 Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification.

Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. The output from the transformer is fed to the rectifier. It converts A.C. into pulsating DC. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification. In positive half cycle only two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias.

3.1.11 Diode(1N4007)

Diode is an electronic component that allows the flow of current in one direction and are commonly used in DC power supply units such as rectifier, voltage regulators, clipper and clampers etc. By doping an intrinsic semiconductor crystal, it can be converted into an n-type or a p-type extrinsic semiconductor crystal.

3.1.12 Capacitor

A capacitor is an electronic device that stores electric energy. It is similar to a battery, but it smaller, lightweight and a capacitor charge or discharges much quicker. Capacitors are used in many electronic devices today, and can be made out of many different types of material. Capacitors are usually made with two metal plates that are on top of each other and near each other, but that do not actually touch. When powered, they allow energy to be stored inside an electrical field. Because the plates need a lot of area to store even a small amount of charge, the plates are usually rolled up into some other shape, such as a cylinder.

3.2 Software Requirements

Atmega32 can be programmed either by In-System Programming via Serial peripheral interface or by Parallel programming. Programming via JTAG interface is also possible. Programmer must ensure that SPI programming and JTAG are not be disabled using fuse bits; if the programming is supposed to be done using SPI or JTAG.

CHAPTER 4

DESIGN

4.1 Introduction

Wireless communication has been booming in the recent years. However, not much has been done to accomplish communication in water in a wireless manner which can be useful in many scenarios. Most of the communication modes that are existing as of now are either not reliable or are very expensive. IR rays can pass through water and thus can be used in case of line of sight for communication purpose in this medium. IR Communication using Keyboard uses two units both controlled by ATmega family microcontroller. Both of the units have IR Trans-receivers as communicating agents. Keyboards are needed to be connected on both the ends to enter input to the system.

The communication messages get displayed on the LCD connected to the system. The system communicates with confirmation key that is sent back by the receiving unit to the sending unit. In this way wireless communication is implemented with great efficiency within a line-of-sight range of about 3-4 meters under the water with the help of IR Communication using Keyboard project.

4.2 Block diagram

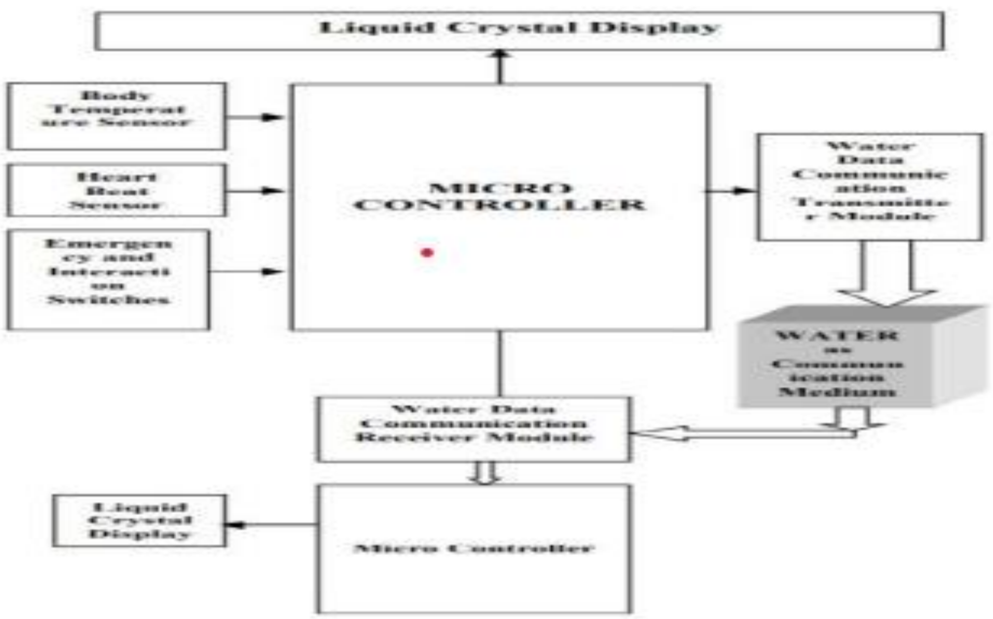

Figure 4.1: block diagram of IR underwater communication system

4.3 Flow diagram

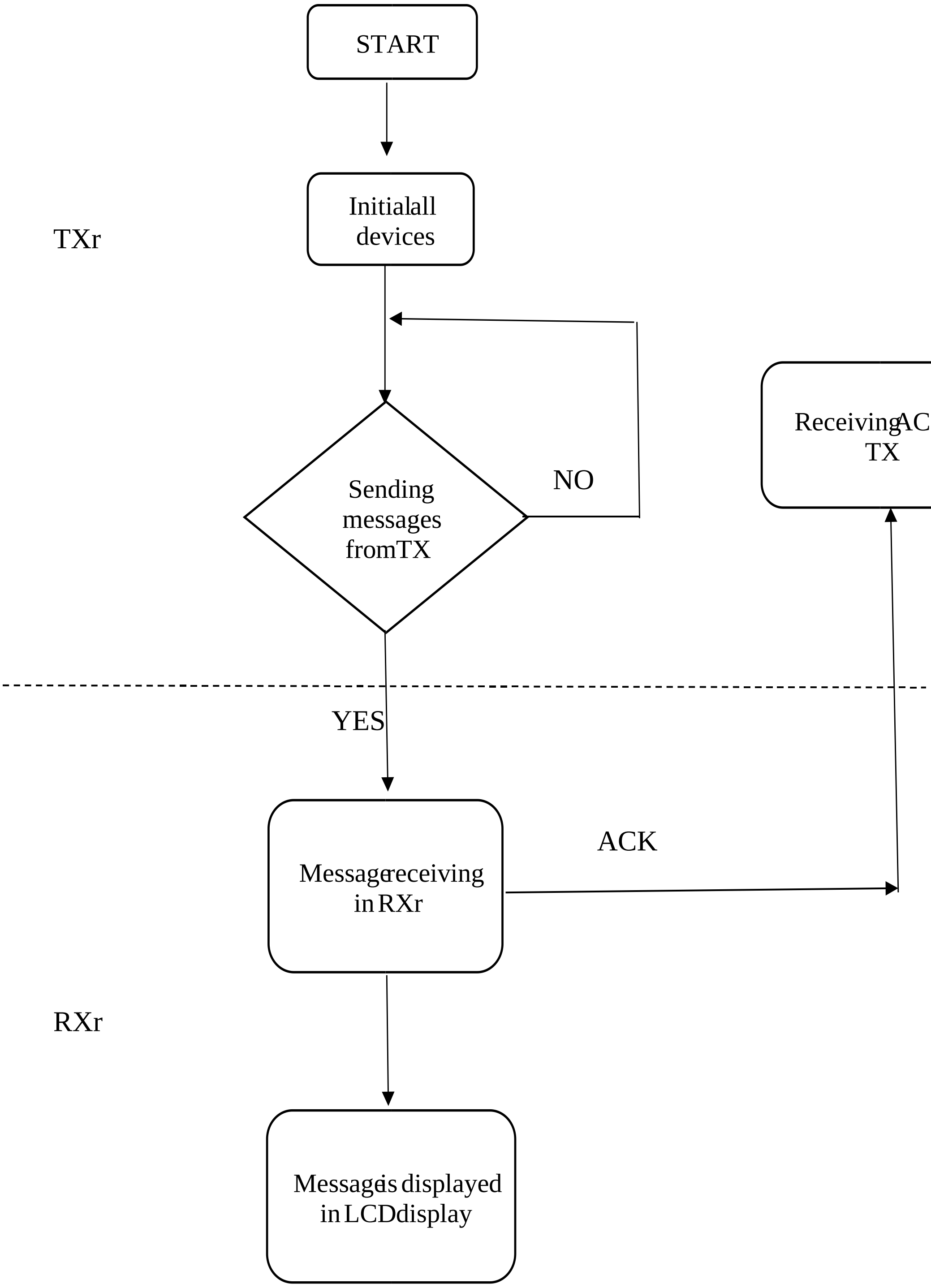

Figure 4.2: Flow chart diagram of IR underwater communication system

CHAPTER 5

IMPLEMENTATION

5.1 Module Implementation

Basically transformer, voltage regulator, rectifier, IR LED, TSOP, crystal oscillator, diodes, capacitors, LCD display and ATmega MC with preinstalled code were soldered on the Printed Circuit Board(PCB). By using keyboard we are going to type the message and send it over IR led with water as medium and going to establish a communication we also designed it in a way were we can recieve the acknowledgement to check if message is send or not as shown in fig 5.1.

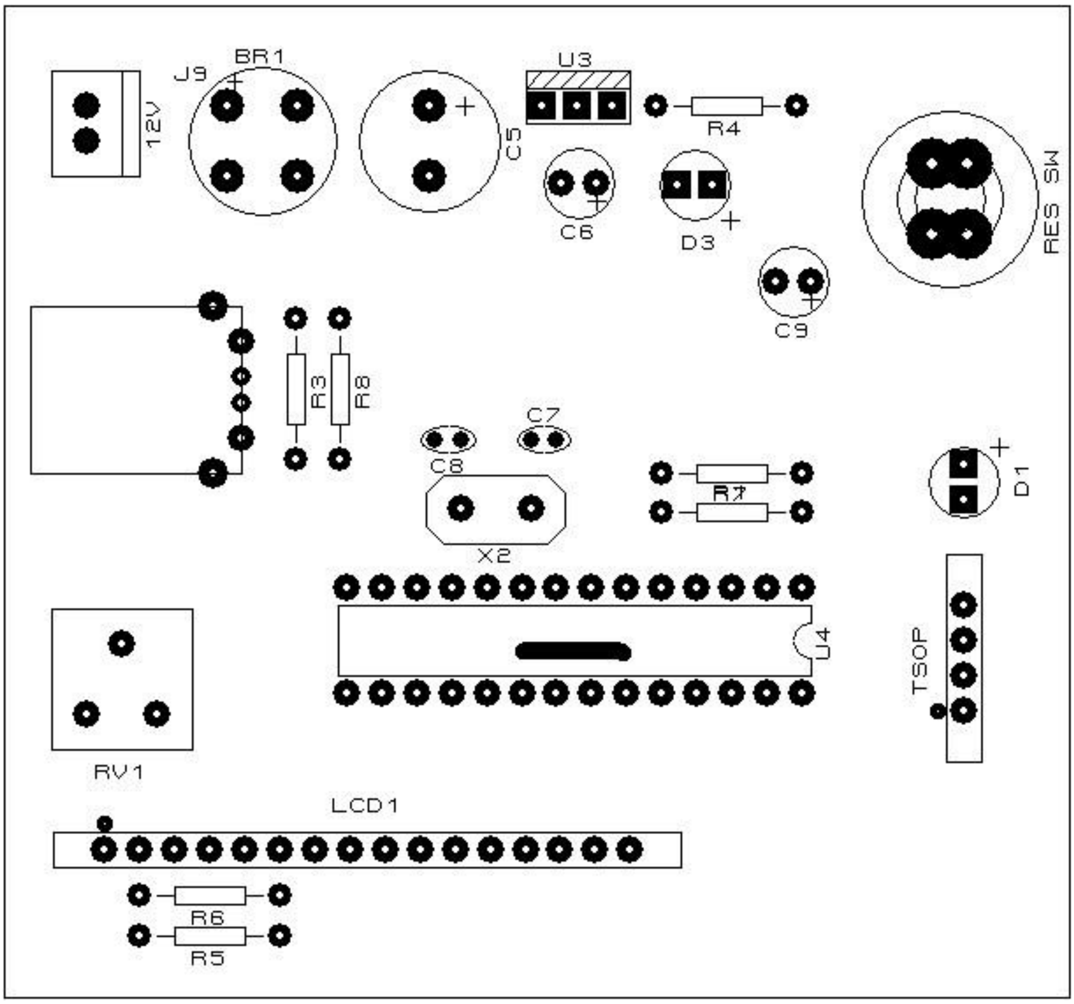

Figure 5.1: PCB design layout

5.2 Arduino Implementation

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub main () into an executable cyclic executive program.

5.3 Algorithm

Point-to-Point Protocol. In computer networking, Point-to-Point Protocol is a data link layer communications protocol between two routers directly without any host or any other networking in between. It can provide connection authentication, transmission encryption, and compression.

STEP 1: START

STEP 2: Initial all devices.

STEP 3: If (Sending message from transmitter):

THEN: Message received in receiver

ELSE:

Goto STEP 3

STEP 4: Receiving ACK in transmitter.

STEP 5: Message is displayed in LCD display.

STEP 6: Process repeat until Message delivered is completed.

STEP 7: STOP

5.4 Source Code

```
/* * IRremote: IRsendDemo - demonstrates sending IR codes with IRsend
* An IR LED must be connected to Arduino PWM pin 3.
* Version 0.1 July, 2009
* Copyright 2009 Ken Shirriff
* http://arcfn.com */

#include <IRremote.h>          // header files
#include <PS2Keyboard.h>
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>

void setup()                   // structure of Arduino programme
{
keyboard.begin(DataPin, IRQpin);
lcd.begin(lcd_col,lcd_row);
lcd.print(" IR communication ");
delay(2000);
lcd.clear();
irrecv.enableIRIn();
lcd.setCursor( 0 , 0);
lcd.print("msg: ");
lcd.setCursor( 0 , 1);
lcd.print(" ");
lcd.setCursor( 0 , 2);
lcd.print("you: ");
lcd.setCursor( 0 , 3);
lcd.print(" ");
}
void loop()
{
if (keyboard.available())
{
```

```
if(clear_lcd == 1)
{
lcd.setCursor( 0 , 2);
lcd.print("you: ");
lcd.setCursor( 0 , 3);
lcd.print(" ");
clear_lcd = 0;
}
// initialize the library with the numbers of the interface pins LiquidCrystal
lcd(8,9,10,11,12,13);
void setup()
{       keyboard.begin(DataPin,IRQpin);
lcd.begin(lcd_col,lcd_row);
lcd.print("IR            communication”);
delay(2000);
lcd.clear();
irrecv.enableIRIn();
lcd.setCursor( 0 , 0);
lcd.print("msg:");
lcd.setCursor( 0 , 1);
lcd.print(" ");
lcd.setCursor( 0 , 2);
lcd.print("you: ");
lcd.setCursor( 0 , 3);
lcd.print(" ");
}

IRrecv irrecv(RECV_PIN);
IRsend irsend;
decode_results results;
PS2Keyboard keyboard;    // initialize the library with the numbers of the interface pins
LiquidCrystal lcd(8,9,10,11,12,13);
```

```
void setup()
{
keyboard.begin(DataPin, IRQpin);
lcd.begin(lcd_col,lcd_row);
lcd.print(" IR communication ");
delay(2000);
lcd.clear();
irrecv.enableIRIn();
lcd.setCursor( 0 , 0);
lcd.print("msg: ");
lcd.setCursor( 0 , 1);
lcd.print(" ");
lcd.setCursor( 0 , 2);
lcd.print("you: ");
lcd.setCursor( 0 , 3);
lcd.print(" ");
 }
void loop() {
if (keyboard.available())
{
if(clear_lcd ==1)
{
lcd.setCursor( 0 , 2);
lcd.print("you: ");
lcd.setCursor( 0 , 3);
lcd.print(" ");
clear_lcd = 0;
}
```

CHAPTER 6

TESTING

6.1 Positive Test Case

a) Short range distance

Figure 6.1: Short distance

As the distance between transmitter and receiver is less, the time taken to receive the message is also less. For short distance the length of the message does not matter. Short length and long length message are sent and received at same amount of time as shown in figure 6.1.

b) Mid range distance

Figure 6.2: Medium distance

As the distance between transmitter and receiver is in mid-range, the time taken to receive the message is relatively more than short range. For medium distance the length of the message does not matter. Short length and long length message are sent and received at same amount of time as shown in figure 6.2.

c) Long range distance

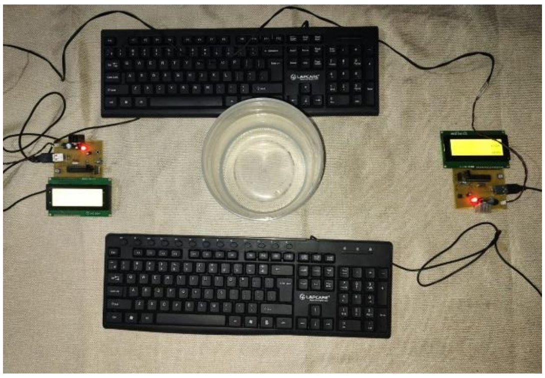

Figure 6.3: Long distance

As the distance between transmitter and receiver is maximum, the time taken to receive the message is also maximum. For long distance, if the length of the message consists of less characters time required to receive the message is less. For long distance, if the length of message consists of more characters time required to receive the message is more. Short length and long length message are sent and received at different timing as shown in figure 6.3.

6.2 Negative Test Case

Figure 6.4: Out of range

As the distance between transmitter and receiver is out of range, the message is not sent and we get “Message Failed” feedback on display. Short length and long length message cannot be sent and received. Therefore, the time cannot be measured in this case as shown in figure 6.4.

CHAPTER 7

RESULTS

Figure 7.1 Overview of IR wireless communication system

Description

a) IR wireless is the use of wireless technology in devices or systems that convey data through infrared (IR) radiation.

b) Infrared is electromagnetic energy at a wavelength or wavelengths somewhat longer than those of red light.

c) IR wireless is used for short- and medium-range communications and control. The systems operate in line-of-sight mode.

d) This means that there must be a visually unobstructed straight line through space between the transmitter(source) and receiver (destination).

e) We are using keyboard for both transmitting and receiving messages through water as a medium. Our device is a transreceiver model where communication happens.

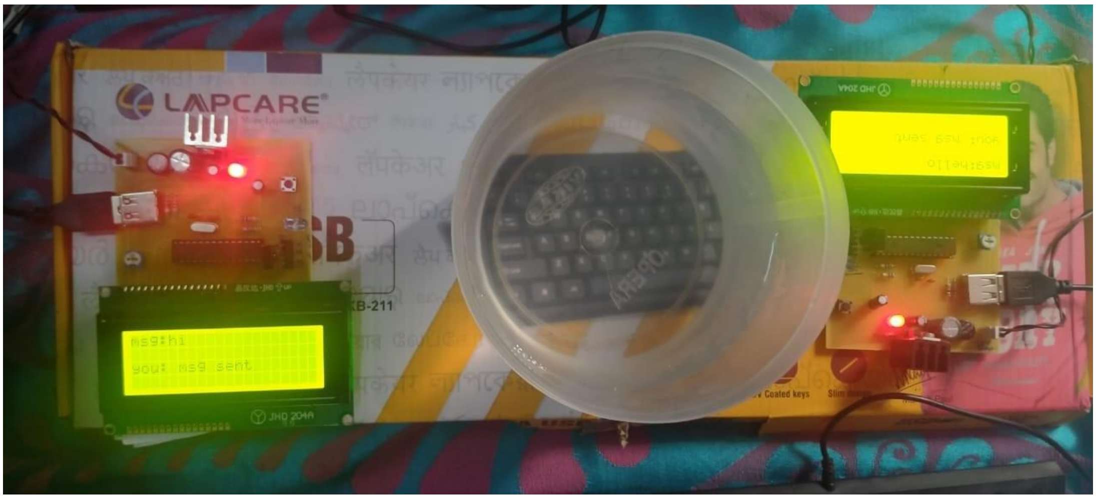

Figure 7.2 Output of the model

OUTPUT

a) Our system is a transreciever so we can receive and transmit in both ways. Power supply is provided to both the ends then it will reach the voltage regulator through bridge circuit.

b) Voltage regulator is provided with heat sink which helps in removing unwanted heat through ambient surroundings.We used different capacitors and resistors which helps in boosting the overall function of the device.

c) crystal oscillator is used to provide clock pulses to the microcontroller. Switch is used to reset the messages in the display.

d) IR led is used to transmit the messages and TSOP is used to receive the messages as shown in fig 7.2.

Advantages

a) This system has unique advantages such as minimal effort with low cost.

b) High speed communication and almost no limitations of bandwidth range.

c) The transmitter or receiver can be showed to another location with least distraction.

d) This system is used for easy communication with transmitter and receiver in underground water.

Applications

In last several years, underwater communication network has found an increasing use in a widespread of applications such as follows .

a) Military and Commercial purposes.

b) Coastal surveillance systems.

c) Environmental research.

d) Autonomous underwater vehicle(AUV) operation.

e) Collection of data for water monitoring system.

f) Linking submarines to land.etc.

Feedbacks on project

a) Infrared frequencies are affected by hard objects e.g. walls, doors, smoke, dust, fog, sunlight etc. Hence it does not work through walls or doors.

b) In monitor & control application, it can control only one device at one time. Moreover it is difficult to control things which are not in LOS (Line of Sight). It requires line of sight between transmitter and receiver to communicate.

c) Underwater sensors cannot share data with those ashore,as both use different wireless signals that only work in their corresponding mediums.

CONCLUSION & FUTURE ENHANCEMENT

CONCLUSION

Proper exploitation of the ocean environment for communications requires a clear understanding of the mechanisms affecting the underwater signal, such as the attenuation characteristics originated from the propagation properties of RF, optical, and acoustic transmissions.

Modeling underwater signal propagation is very difficult but its understanding play as key role to determine the effective data processing at the transmitter and at the receiver so that reliable and accurate communications are possible. As expected, each communication technology requires distinct channel modeling, turning the task of conceiving a network employing flexible modems much more challenging.

FUTURE ENHANCEMENT

Future generation modems for certain will include many signal processing tools in order to achieve high data rates at the physical layer when employing any of the technologies available or a combination of them whenever the environmental conditions allow.

Reaching data rates nearing theoretical channels capacities is a desired objective to be accomplished with the indispensable aid of today’s ubiquitous signal processing tools. This paper contributes in this direction by providing an up-to-date survey of the main technical aspects and research challenges of wireless underwater communication

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