A

Mini Project Report

on

"UNDERWATER WIRELESS COMMUNICATION SYSTEM"

Submitted By,

RAHUL NARENDRA IPTE (PRN No.: 21303313720503)

DIKSHA PUNDLIK KHARVILKAR (PRN No.: 2130331372505)

Under guidance of

Dr. Pallavi Ingale

Department of Electronics & Telecommunication Engineering

Dr. Babasaheb Ambedkar Technological University,

Lonere-402103

2022-2023

A

Mini Project Report

on

"UNDERWATER WIRELESS COMMUNICATION SYSTEM"

Submitted By,

RAHUL NARENDRA IPTE (PRN No.: 2130331372503)

DIKSHA PUNDLIK KHARVILKAR (PRN No.: 2130331372505)

Under the guidance of

Dr. Pallavi Ingale

In the fulfillment of B. Tech. in Electronic & Telecommunication Engineering course of Dr. Babasaheb Ambedkar Technological University, Lonere (Dist.-Raigad) in the academic year 2022-2023.

Department of Electronic & Telecommunication Engineering

Dr. Babasaheb Ambedkar Technological University,

Lonere-402103

2022-2023

Dr. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY

"VIDYAVIHAR", LONERE- 402103. Tal. Mangaon, Dist. Raigad. (Maharashtra State) INDIA

CERTIFICATE

This is to certify that the mini project entitled **"Underwater Wireless Communication System"** has been carried out by

Mr. Rahul Narendra Ipte (2130331372503)

Miss. Diksha Pundlik Kharvilkar (2130331372505)

is record of Bonafide work carried out by them under my guidance in the fulfillment in Electronic & Telecommunication Engineering course of Dr. Babasaheb Ambedkar Technological University, Lonere (Dist. Raigad) in the academic year 2022-2023.

Dr. Pallavi Ingale
Project Guide

Dr. S. L. Nalbalwar
Prof. and Head Dept. of
Electronics & Telecommunications, Engineering
Dr. Babasaheb Ambedkar Technological
University, Lonere (402103)

External Examiner

Date:

Place: Lonere

ACKNOWLEDGEMENT

We thank **Dr. Sanjay L. Nalbalwar** Head of Electronic and Telecommunication Engineering Department, for his valuable suggestion and cooperation in the completion of the technical mini-project.

We thank **Dr. Pallavi Ingale**, Professor of Electronic and Telecommunication Engineering Department, for her valuable suggestions in the completion of the technical mini-project.

We thank **Prof. Tejas U. Mahagaonkar**, Assistant Professor of Electronic and Telecommunication Engineering Department, and coordinator of the Minor project, for his valuable suggestions in the completion of the technical mini-project.

We thank to **Mr. Santosh Batawale**, Lab Assistant of Electronics and Telecommunication Engineering Department, for his valuable help for providing components for completion of the Mini-project.

Rahul Narendra Ipte
(2130331372503)

Diksha Pundlik Kharvilkar

(2130331372505)

INDEX

LIST OF FIGURES

ABSTRACT

Underwater wireless communications system comprising first and second communications modules which transmit and receive data utilizing infrared radiation. Each module has a transmitter/receiver which converts each received data. The infrared light detecting unit then provides a logic zero at its output when it receives a pulsed burst of infrared radiation for time period of approximately six hundred microseconds and a logic one when the unit fails to detect a pulsed burst of infrared radiation for a time period of six hundred microseconds. Wireless infrared (IR) communication system is meant to use free space propagation of light waves as a transmission medium in near infrared band.

Message communication is implemented by using IR as a source that is established a light communication (link to transmit and receive data via infrared light). The outcome of this proposed work is to design and implementation an optical wireless system to transmit data over a certain distance. This system has many advantages such as is an inexpensive and the transmitter or receiver can be showed to another location with least distraction. This system is used for easy communication with transmitter and receiver in underground water. if they need any help means the transmit the signal using IR transmitter remote the signal transfer to IR receiver circuit. So thus, why they can easily identify the information.

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.

CHAPTER 1
INTRODUCTION

Wireless communication allows information to be transmitted between two devices without using wire or cable. The data is being transmitted and received using electromagnetic radiation, the electromagnetic spectrum orders electromagnetic energy according to wavelength or frequency, the electromagnetic spectrum ranged from energy waves having Extremely Low Frequency (ELF) to energy waves having much higher frequency, e.g., x-rays. Infrared is an electromagnetic radiation has a wavelength longer than that of visible light but shorter than radio waves and has wavelength between (750 nm-1mm) Infrared LEDS are classified into Near Infrared (NIR) and Far Infrared (FIR). In this project (NIR) is our interest, it is divided into two bands the long wave and short wave (NIR), So the used part of the infrared spectrum in laser communication system is divided into various bands based on the type of the light sources, transmitting\absorbing materials (fibres) and detectors. IR communication system consists of three main parts transmitter circuit, medium propagation (IR) and receiver circuit. In this project, short distance transmission of signal is realized by the design and achievement of infrared communication link.

Underwater wireless communication is essential for a range of applications, including environmental monitoring, underwater exploration, and surveillance. However, the harsh underwater environment presents several challenges to wireless communication, including attenuation, multipath propagation, and interference. Traditional wireless communication methods such as acoustic or radio frequency suffer from limited range and low bandwidth. Therefore, there is a need for an effective and efficient method for underwater wireless communication.

Infrared technology has emerged as a promising solution for underwater wireless communication due to its ability to transmit high-bandwidth data over long distances with minimal interference. Infrared technology has been successfully used in various applications such as building automation, industrial control, and medical devices. In recent years, researchers have focused on developing infrared-based systems for underwater wireless communication.

CHAPTER 2
BLOCK DIAGRAM

2.1 Basic Block Diagram:

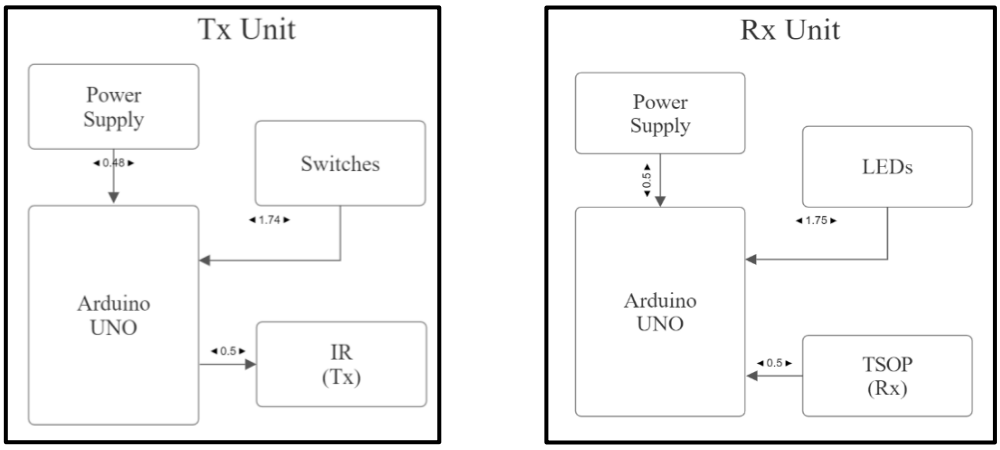

Fig. 2.1: Basic Block Diagram

2.2 Block Diagram Description:

The basic block diagram of the underwater water communication system is shown in the above figure. Mainly this block divided into the two-parts transmitter unit and receiver unit this unit consists the following essential blocks.

- Power Supply
- Arduino UNO R3
- Slide Switches
- IR LED (Tx)
- LED’s
- TSOP 1738 (Rx)

2.2.1 Power Supply:

Here we used +5V DC power Supply from computer USB or battery. The main function of this block is to provide the required amount of voltage to essential circuit. +5V is given to IR LED sensor, TSOP sensor, LEDs, and switches.

2.2.2 Arduino UNO R3

An Atmel ATmega328P microcontroller is a 40 pin DIP package. It has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. There are 14 digital I/O pins and 6 Analog I/O pins.

2.2.3 Slide Switches

A slide switch is a mechanical switch that slides from the open (off) position to the closed (on) position and allows control of a circuit's current flow without having to manually splice or cut wire.

2.2.4 IR LED (Tx)

An Infrared light-emitting diode (IR LED) is a special-purpose LED that emits infrared rays ranging from 700 nm to 1 mm wavelength. Different IR LEDs may produce infrared light of differing wavelengths, just like other LEDs produce light of different colours. IR sensor is a device that uses infrared technology to detect objects or changes in the environment. IR sensors can detect a wide range of physical properties such as temperature, motion, and proximity.

2.2.5 LEDs

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.

2.2.6 TSOP 1738 (Rx)

TSOP1738 is an IR receiver with an amplifier that acts as a switch and converter within a circuit. It has a single input and output that only reacts to the input IR signal. The TSOP1738's main function is to convert IR impulses to electric signals. Every IR receiver operates on a specific frequency. TSOP1738 operates on a 38 kHz IR frequency. It may act owing to a current leakage or other problems if the frequency is higher or lower, but it will not fully perform. It employs silicon-based technology, which operates on a micro-scale and is extremely sensitive and efficient in its activities.

CHAPTER 3
CIRCUIT DIAGRAM

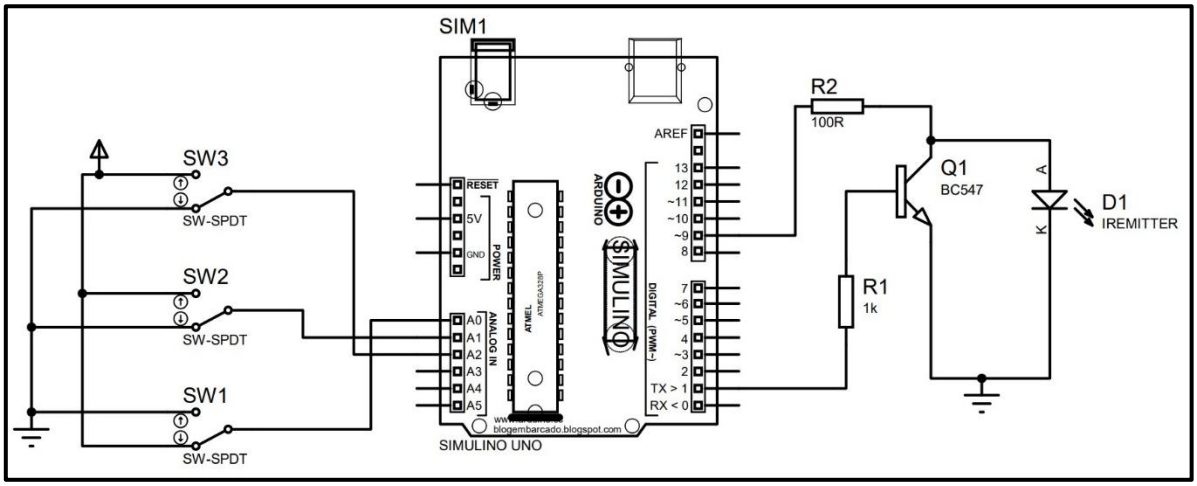

Fig. 3.1: Circuit Diagram for Transmitter

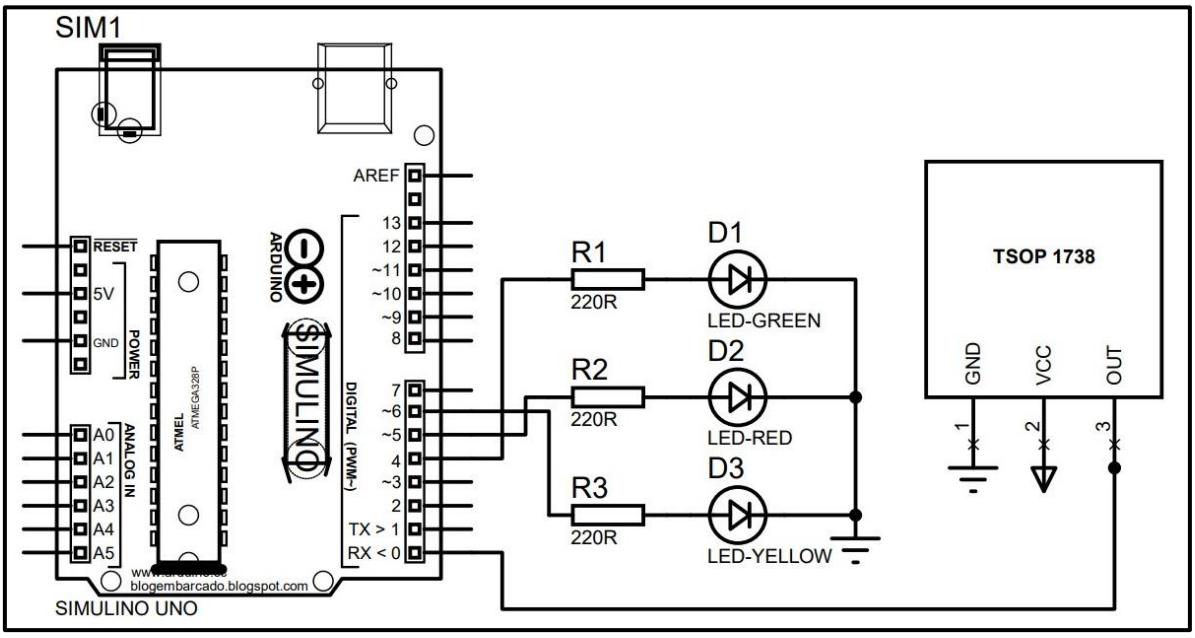

Fig. 3.2: Circuit Diagram for Receiver

We are using two circuit for the transmitting and receiving purpose. In the transmitting side we are using IR led which is controlled by using Arduino and BC547 transistor. For controlling the led at receiver side we are using the slide switch. In the receiver side, we are using the TSOP 1738 receiver which receivers the transmitted signal. The LEDs are connected to the Arduino which is controlled by using the slide switch at the transmitter side this operation performed wirelessly under the water.

CHAPTER 4
WORKING

Underwater wireless communications play an important role in marine activities such as environmental monitoring, underwater exploration, and scientific data collection. Here when Scooba divers go into water sometimes they need help under water or they need to coordinate with ship or ground station that time they cannot come on surface again and again so for that this system helps communicating with ground station or ship by this underwater wireless communication system following is the step by step working of the system,

- In this project, there are two important circuit that are transmitter circuit and receiver circuit.
- Both transmitter circuit and receiver circuit are connected to the separate power supply and separate Arduino.
- At transmitter side, there are three switches named as S1, S2, and S3 respectively. At receiver side there are three LEDs named as L1 for Green, L2 for Red, and L3 connected to the Arduino respectively.
- When S1 switch is pressed, Arduino reacts to it by sending digital pulse to transistor sends this pulse to IR diode which emits the IR wave.
- This IR wave are received by TSOP 1738. This TSOP 1738 received pulse to Arduino. Arduino checks pulses and compare it with store information, if pulses are matched the respective LED glows and indicate the message.
- For the green LED as everything is fine or something new found under the water, for the red LED emergency alert or take me on the ship, and for the yellow LED I need a help.

CHAPTER 5
COMPONENTS

5.1 List of Components

1. Arduino UNO
2. IR LED
3. TSOP 1738
4. Slide Switches
5. LEDs
6. Breadboard
7. Connecting Wires

5.2 Description of Components

5.2.1 Arduino UNO

An Arduino is an open-source microcontroller development board. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on computer, used to write, and upload computer code to the physical board.

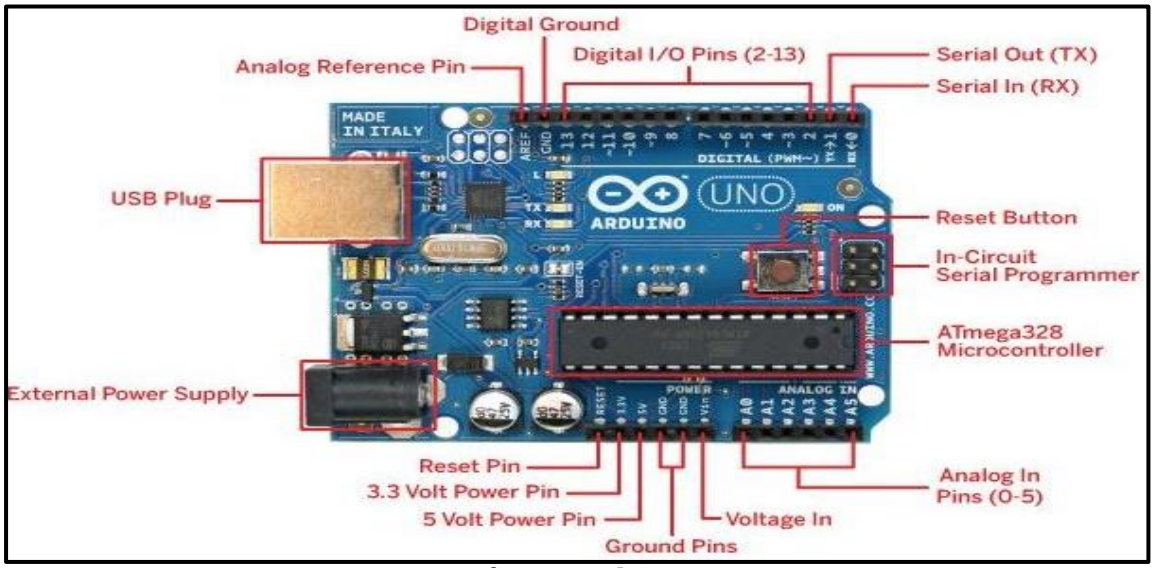

fig. 5.1: Arduino UNO

The board features an Atmel ATmega328 microcontroller operating at 5V with 2KB of RAM, 32KB of flash memory for storing programs and 1KB of EEPORM for storing parameter. The clock speed is 16 MHz, which translates to about executing about 3,00,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog inputs pins.

Arduino UNO R3 Specifications:

- It is an ATmega328P based Microcontroller
- The Operating Voltage of the Arduino is 5V
- The recommended input voltage ranges from 7V to 12V
- The i/p voltage (limit) is 6V to 20V
- Digital input and output pins-14
- Digital input & output pins (PWM)-6
- Analog i/p pins are 6
- DC Current for each I/O Pin is 20 mA
- DC Current used for 3.3V Pin is 50 mA
- Flash Memory -32 KB, and 0.5 KB memory is used by the boot loader
- SRAM is 2 KB
- EEPROM is 1 KB
- The speed of the CLK is 16 MHz
- In Built LED
- Length and width of the Arduino are 68.6 mm X 53.4 mm
- The weight of the Arduino board is 25g

5.2.2 IR LED

An Infrared light-emitting diode (IR LED) is a special-purpose LED that emits infrared rays ranging from 700 nm to 1 mm wavelength. Different IR LEDs may produce infrared light of differing wavelengths, just like other LEDs produce light of different colours. IR sensor is a device that uses infrared technology to detect objects or changes in the environment. IR sensors can detect a wide range of physical properties such as temperature, motion, and proximity.

IR LEDs are usually made of gallium arsenide or aluminium gallium arsenide. In complement with IR receivers, these are commonly used as sensors.

The appearance of an IR LED is the same as a common LED. Since the human eye cannot see infrared radiation, it is not possible for a person to identify if an IR LED is working. A camera on a cell phone camera solves this problem. The IR rays from the IR LED in the circuit are shown in the camera.

An IR LED is a type of diode or simple semiconductor. Electric current is allowed to flow in only one direction in diodes. As the current flows, electrons fall from one part of the diode into holes on another part. In order to fall into these holes, the electrons must shed energy in the form of photons, which produce light.

It is necessary to modulate the emission from the IR diode to use it in the electronic application to prevent spurious triggering. Modulation makes the signal from IR LED stand out above the noise. Infrared diodes have a package that is opaque to visible light but transparent to infrared. The massive use of IR LEDs in remote controls and safety alarm systems has drastically reduced the pricing of IR diodes in the market.

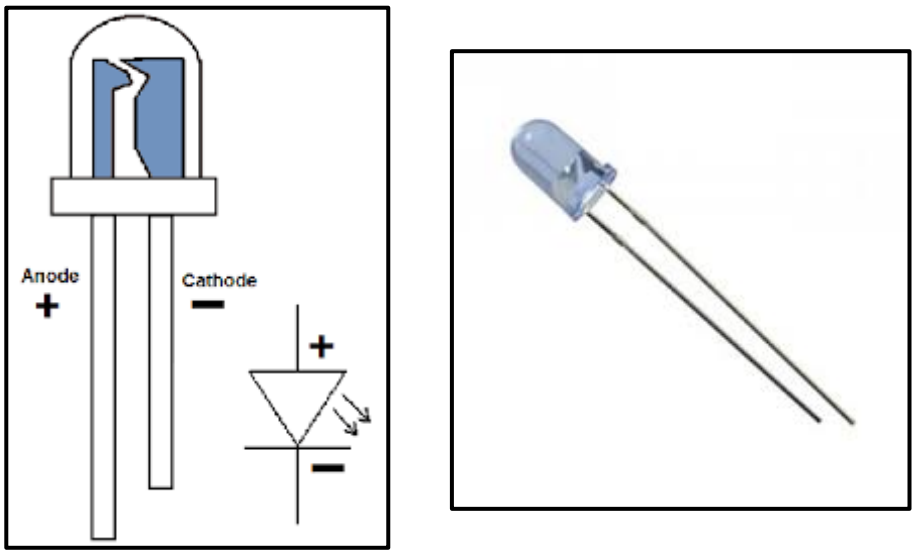

Fig. 5.2: IR LED

Technical Specifications:

- Forward current (IF) is 100mA (normal condition) and 300mA (max.)
- 1.5A of surge forward current
- 1.24v to 1.4v of forward voltage
- Temperature for storage and operation varies from -40 to 100 ℃
- Soldering Temperature should not exceed 260 ℃
- Power Dissipation of 150mW at 25℃ (free air temperature) or below

- Spectral bandwidth of 45nm
- Viewing angle is 30 to 40 degrees

Features

- High Reliability
- Excessive radiant intensity
- Forward voltage is low
- Having led spacing of 2.54mm
- Maximum wavelength is 940nm
- Pb free
- RoHS certified
- Easy to use with breadboard or perf board

2.5.3 TSOP 1738

TSOP1738 is an IR receiver with an amplifier that acts as a switch and converter within a circuit. It has a single input and output that only reacts to the input IR signal. The TSOP1738's main function is to convert IR impulses to electric signals. Every IR receiver operates on a specific frequency. TSOP1738 operates on a 38 kHz IR frequency. It may act owing to a current leakage or other problems if the frequency is higher or lower, but it will not fully perform. It employs silicon-based technology, which operates on a micro-scale and is extremely sensitive and efficient in its activities.

Fig. 5.3: TSOP 1738

Specifications:

- Supply Voltage: 5 V
- Power consumption: 0.4 to 1.0 mA
- Min. Ee irradiation: 0.35 mW/m2 typ.
- Angle of detection: 90
- Dimensions of the casing (mm): 12.5 x 10 x Thickness 5.8
- Temperature range: -25 C to +85 C

Features:

- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against electrical field disturbance
- TTL and CMOS compatibility
- Output active low
- Low power consumption
- High immunity against ambient light
- Continuous data transmission possible (up to 2400 bps)
- Suitable burst length 10 cycles/burst

5.2.4 Slide Switches

It is a mechanical switch that is used to control the flow of current in a circuit by sliding the slider from the OFF (open) position to the ON (close) position known as a slide switch. This switch simply controls the current within a circuit without cutting a wire manually. These switches will stay in one position until changed into another position manually.

The construction of the slide switch can be done by using metal slides that contact the plane metal elements on the switch. When the slider in the switch is moved then metal slide contacts will slide from one set of metal contacts to the other for activating the switch.

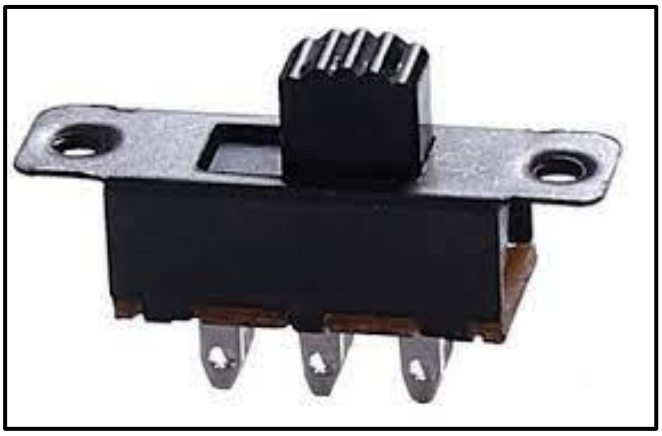

Fig. 5.4: Slide Switch

Specifications:

- The max voltage across the switch or voltage rating is up to 24 Vdc.
- The max current throughout the device or switches current rating is up to 500 mA.
- The height of the actuator is flat or raised.
- The pitch or distance between pins is 2.54 mm or 5.08 mm.
- These switches can oppose dust & moisture.
- Contact rating is 12 V DC, 200 mA.
- Operating temperature ranges from -10o C to + 60o C.
- Minimum mechanical life 5000 operations.
- Contacts are silver-plated and phosphor bronze.
- Terminals are brass silver-plated.
- Contact timing is non-shorting.

2.5.5 LEDs

The LED is a PN-junction diode which emits light when an electric current passes through it in the forward direction. In the LED, the recombination of charge carrier takes place. The electron from the N-side and the hole from the P-side are combined and gives the energy in the form of heat and light. The LED is made of semiconductor material which is colourless, and the light is radiated through the junction of the diode.

Fig. 5.5: LEDs

Advantages:

- The LED are smaller in sizes, and they can be stacked together to form numeric and alphanumeric display in the high-density matrix.
- The intensity of the light output of the LED depends on the current flows through it. The intensity of their light can be controlled smoothly.
- The LED are available which emits light in the different colours like red, yellow, green, and amber.
- The on and off time or switching time of the LED is less than of 1 nanosecond. Because of this, the LED are used for the dynamic operation.
- The LEDs are very economical and giving the high degree of reliability because they are manufactured with the same technology as that of the transistor.
- The LED are operated over a wide range of temperature say 0° – 70°. Also, it is very durable and can withstand shock and variation.
- The LED have a high efficiency, but they require moderate power for operation. Typically, the voltage of 1.2V and the current of 20mA is required for full brightness. Therefore, it is used in a place where less power is available.

CHAPTER 6
ADVANTAGES

1. To detect pollution monitoring

The increasing pollution in water makes it more difficult to guarantee the fundamental right to water. With the draining of oil, minerals, chemical products, phosphate, and nitrate into water. Most causes of water pollution. That is, we developed a completely decentralized ad-hoc sensor network for the ocean pollution detection.

2. It avoid data spoofing

Spoofing means malware or attack. It avoids unauthorized access; third party cannot steal the data or hack the network. Radio waves are electromagnetic waves that used for long-distance communication. It is a high transmission power.

3. Security

Underwater Communication systems are instrumental in ensuring the security of a nation. It is used by the military, to conduct underwater surveillance, as well as to detect intrusion.

4. Economy

Underwater communication systems are useful for commercial purposes; particularly in industries such as oil and gas. The ocean is full of a lot of resources, and these systems are used in carrying out exploration of these resources.

5. Scientific Exploration and Data Collection

These systems are also very beneficial to science; as it is used for exploration and data collection underwater. It is used in fields like marine biology, marine archaeology, and oceanology.

CHAPTER 7
APPLICATIONS

1. It is additionally utilized in pollution management and climate recording.
2. It also has the application in the detection of the objects on the ocean floor.
3. Underwater wireless communication is also used in environmental monitoring and collecting of oceanographic information.
4. It is the applying in underwater archaeology, search and rescue machines and defence.
5. It is also used in seismic monitoring, pollution monitoring and ocean currents monitoring.
6. The underwater wireless communication is used in the equipment monitoring and control and in the autonomous underwater vehicles (AUV).
7. It is also used in remotely operated vehicles (ROV).
8. It also has the application in the acoustic navigation technology for multiple autonomous underwater vehicles.
9. It is used in solar-powered autonomous underwater vehicles.
10. It is also used in Environmental monitoring like climate recording, pollution control, prediction of natural disaster harbour protection.

CONCLUSION

The use of an IR sensor in an underwater wireless communication system offers several advantages, including low power consumption, low cost, and ease of implementation. The IR sensor allows for data transmission through the water using light waves, which can travel a considerable distance with minimal attenuation. Furthermore, the IR sensor can be integrated with other underwater sensors and devices to create a comprehensive underwater communication network. However, it is important to note that the effectiveness of the IR sensor in an underwater wireless communication system depends on various factors, such as water clarity, depth, and ambient light conditions. Therefore, further research and development are needed to improve the reliability and performance of this technology for practical applications in underwater communication systems.

REFERENCES

[1] Ritik Patil, Yash Yennewar, Tanmay Kawase, Rushikesh Tetwar, Prof. Suhas D. Kakde, "Underwater Wireless Communication System Using IR Sensor", *International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), ISSN: 2582-5208, Published By, www.irjmets.com – 2023.*

[2] Prof. Ranjith Rajan, Ms. Elizabeth P.T, Ms. Amala Susan Roy, Ms. Aiswarya K.S, Ms. Christymol Bousally, "Underwater Wireless Communication System", *International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Published By, http://www.ijert.org – 2020.*

[3] Mr. K. Rajesh Kumar, K. Mohanraj, A. S. Murugan, K. Naveen, K. Prakash, "IR Wireless Underwater Communication System", *International Research Journal of Engineering and Technology (IRJET) ISSN: 2395-0056, Publish By, www.irjet.net – 2021.*

[4] Dr. P. N. Sudha, H. G. Srinidhi, Abhishek K V, Anushri V K, Bhoomika P K, "IR UNDERWATER WIRELESS COMMUNICATION", *International Research Journal of Engineering and Technology (IRJET) ISSN: 2395-0056, Publish By, www.irjet.net – 2021.*

[5] Ali M.F., Jayakody D.N.K., Chursin Y.A., Affes S., Dmitry S. Recent Advances and Future Directions on "Underwater Wireless Communications," *Arch. Comput. Methods Eng.* 2019:1–34. doi: 10.1007/s11831-019-09354-8.

[6] Camila M. G. Gussen, Paulo S. R. Diniz, Marcello L. R. Campos, Wallace A. Martins, Felipe M. Costa, and Jonathan N. Gois, "A Survey of Underwater Wireless Communication Technologies," *Journal of communication and information systems*, vol. 31, no. 1, 2016