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A Review paper on “IR Wireless Underwater Communication System “

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Abstract- Underwater communication is a critical aspect of various applications, including oceanography, marine biology, underwater robotics, and military operations. In many underwater environments, radio waves and traditional wireless communication methods are ineffective due to the high attenuation of electromagnetic signals in water. In such scenarios, Infrared (IR) communication emerges as a promising alternative. This abstract presents a novel underwater communication system that employs Infrared technology and Raspberry Pi Pico, a low-cost microcontroller, as its core component. The proposed system leverages the unique properties of Infrared light, which can transmit data effectively in water as it experiences minimal attenuation. Raspberry Pi Pico, a versatile microcontroller board, serves as the control unit and data processing platform. It is programmed to modulate data into IR signals, which are transmitted through water over short distances to a receiving unit. The IR Wireless Underwater Communication System using Raspberry Pi Pico offers a cost-effective, efficient, and scalable solution for underwater data exchange. By leveraging Infrared technology, it overcomes the limitations of traditional wireless communication methods in underwater environments. This system holds the potential to enhance various underwater applications, including scientific research,

environmental monitoring, and autonomous underwater vehicles (AUVs).

Keyword- Underwater Communication, Infrared Radiation ,

1. INTRODUCTION

Here we propose an 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 an infrared transmitter receiver to achieve this system. Our system consists of two Raspberry pi Pico microcontroller-based circuits that have IR trans-receiver pairs as well as LCD displays for displaying the messages. We use two water barrels in order to demonstrate underwater communication using IR 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.

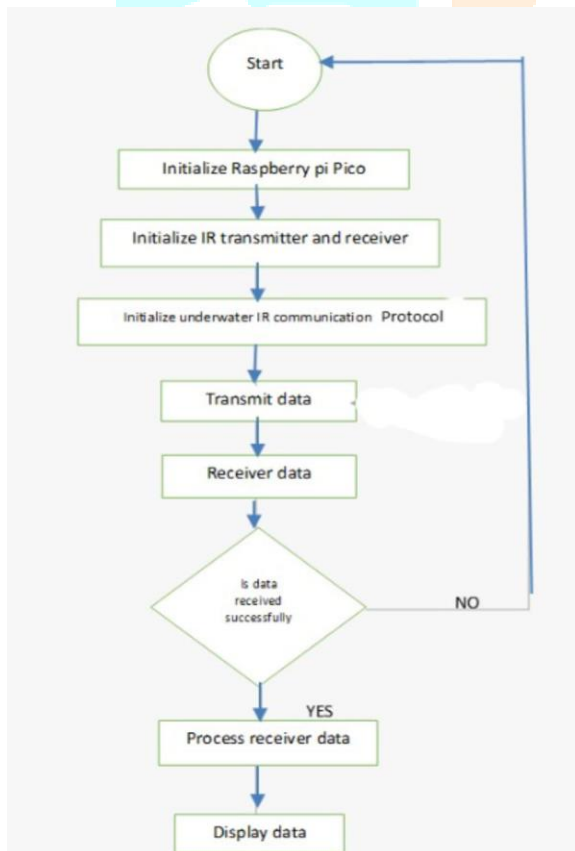
2. AIM

The design of the project is focusing on the transmitting light signal from the transmitter ending to the receiver ending using the infrared light radiation equipment in underwater and this design is said to be underwater wireless communication system.

The aim is to develop an efficient and affordable IR wireless underwater communication system using the Raspberry Pi Pico that can be used for various underwater application , including research , exploration , and monitoring.

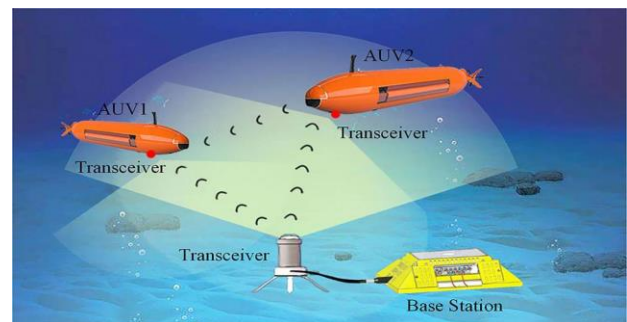
3. WORKING PRINCIPLE

The working of an IR (Infrared) wireless underwater communication system using Raspberry Pi Pico Data to be transmitted is encoded into a suitable format. This encoding ensures that the information can be reliably transmitted and decoded at the receiving end.

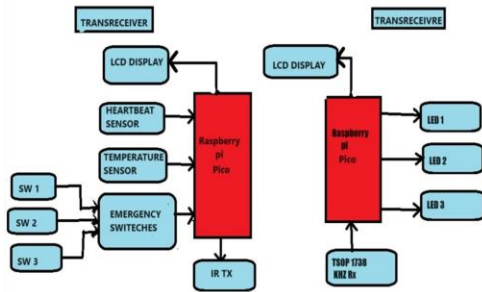


The encoded data is then modulated onto an infrared carrier signal. Modulation varies the characteristics of the carrier signal (such as its intensity or frequency) according to the data being transmitted, preparing it for underwater transmission. The Raspberry Pi Pico, equipped with suitable hardware, acts as the IR transmitter. It controls the modulation

and emission of the IR signal into the underwater environment. Infrared light is used because it experiences minimal attenuation in water, allowing it to travel through the medium without significant signal loss. The emitted IR signal propagates through the water towards the receiver. At the receiving end, another Raspberry Pi Pico, serving as the IR receiver, is used to capture the incoming IR signal. It is equipped with IR-sensitive components to detect the IR light. The received IR signal is demodulated by the receiving Raspberry Pi Pico to extract the encoded data from the carrier signal. Demodulation reverses the process applied during modulation, revealing the original data. The demodulated data is decoded to revert it to its original format. The decoding process ensures that data is in a usable form for further analysis or control. The Raspberry Pi Pico at the receiving end processes the decoded data. It can perform tasks such as error checking and correction, data analysis, or command execution based on the system's design and intended application. Finally, the processed data can be presented to the user or utilized within the underwater system's application. This may involve displaying data, controlling equipment, or interacting with other systems for various underwater tasks. Operation is the effective use of the Raspberry Pi Pico microcontroller boards at both the transmitting and receiving ends. The Raspberry Pi Pico facilitates data encoding, modulation, demodulation, data processing, and interface with the infrared hardware components, enabling reliable wireless communication in an underwater environment.



4. PROPOSED SYSTEM



The proposed system of an IR (Infrared) wireless underwater communication system using Raspberry Pi Pico involves the integration of various components and technologies to enable effective data exchange in underwater environments.

The Raspberry Pi Pico serves as the central control unit and data processing platform for the system. This compact and cost-effective microcontroller board is responsible for data encoding, modulation, and interfacing with other hardware components.

5. METHODOLOGY

An infrared (IR) wireless underwater communication system uses two communication modules to transmit and receive data using infrared radiation. Each module has a transmitter - receiver that transmit and convert the received data. The water acts as a medium between the transmitter and receiver. The system can be used to communicate messages through water.

The IR wireless underwater communication system represents a valuable addition to underwater technology, offering a reliable means of transmitting data between the waves. Continued research and innovation in this field have the potential to unlock even more possibilities for underwater exploration and communication .

- **RASPBERRY PI PICO:** Raspberry Pi Pico is a low-cost, high-performance microcontroller board with flexible digital interfaces. It supports the I2C protocol, which uses two wires to communicate. Key features include:

- Dual-core Arm Cortex M0+ processor, flexible clock running up to 133 MHz
- Low-power sleep and dormant modes
- Drag-and-drop programming using mass storage over USB
- 26 × multi-function GPIO pins
- 2 × SPI, 2 × I2C, 2 × UART, 3 × 12-bit ADC, 16 × controllable PWM channels
- Accurate clock and timer on-chip
- 8 × Programmable I/O (PIO) state machines for custom peripheral support

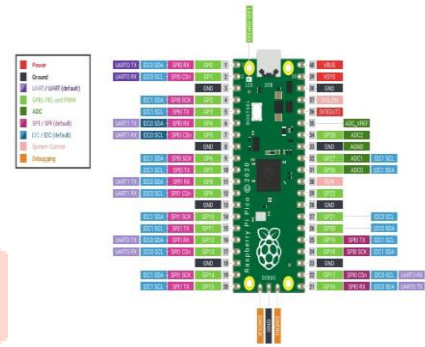


Fig 1. Raspberry Pi Pico

- **ULTRASONIC SENSOR (LM393):** The LM393 is useful since it has an open collector output that allows it to drive loads. Operating voltage is 1.5V to 10V, Frequency range is 50Hz to 20KHz, Diameter is 9.7mm, Hight is 7mm.



Fig 2. Ultrasonic sensor (JSN-SR04T)

- **TEMPERATURE SENSOR:** The sensor has a 2.7V to 3.3V supply voltage range, Low 600μA supply current, and Oceanographers use underwater temperature sensors to collect data on ocean temperatures at different depths.



Fig 3. Temperature Sensor

- **HEARTBEAT SENSOR:** Heartbeat deduction output : LED,VCC : +5v DC (high-quality regulation), Light source 660nm super Red LED Output data level 5V TTL. The optical heart sensor supports a range of 30–210 beats per minute. In underwater activities like scuba diving, commercial diving, or scientific research, divers wear heartbeat sensors to monitor their heart rates. This information is crucial for assessing their physiological state. If a diver experiences an abnormal heart rate, it can be an early indicator of distress or panic.



Fig 4. Heartbeat Sensor

- **Emergency Switches:** voltage and current ratings: 6A, 250V (ON & OFF), Normally open or closed, type of switch, number of poles and throws, and illuminated or non- illumination.



Fig 5. Emergency switch

6. ACKNOWLEDGEMENT

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