IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Scuba Diving Safety System using Li-Fi Technology

[1]Sahanashree H K, [2] Ranganatha gowda H R, [3]Nandan K, [4] Vishwanath c betageri ,[5] Latha H C

[1]Assistant professor, [2]Student, [3]Student [4] Student.,[5] Student

[1]Department of Electronics and Communication,

[1]Sri Siddhartha school of engineering, Tumkur, Karnataka.

Abstract: Scuba diving is an exhilarating and adventurous activity that allows individuals to explore the depths of the underwater world. However, it also comes with inherent risks, including communication difficulties and safety concerns. One in all the main issues with diving is that the health problems faced by the diver's throughout diving and there comes the necessity for observance of diver's health. The system employs Li-Fi technology to enhance safety and well-being of underwater explorers and to transmit health data from the scuba diver to the surface, providing real-time monitoring of vital signs, such as heart rate, oxygen levels, and body temperature. In addition to real-time monitoring, this system is equipped with an abnormal health situation detection feature. When the diver's health parameters deviate from the normal range, a proactive warning is sent to the surface through the Li-Fi connection. Moreover, in critical situations where a diver's health deteriorates rapidly, the system triggers an emergency response mechanism. To further enhance safety, the innovative air balloon mechanism has been integrated which is carried by the scuba diver. In the event of a detected abnormal health situation, the air balloon is designed to rapidly inflate and rise to the surface, carrying the diver with it. This technology has the potential to revolutionize scuba diving safety and save lives in the underwater.

***Index Terms* -** Li-Fi technology, Scuba diving, real-time monitoring.

I. INTRODUCTION

Scuba diving, with its mesmerizing underwater landscapes and the thrill of exploring the ocean's depths. Exploration of the underwater world, whether for scientific research, recreational diving, or industrial purposes, has long been a captivating but challenging endeavor. Ensuring the safety and well-being of scuba divers in the depths of the ocean is of paramount importance. To address this concern, a ground breaking technology known as Li-Fi-based Scuba Diver's Health Monitoring System has been developed, offering real time health monitoring and a remarkable feature for handling abnormal health situations. This innovative system leverages Li-Fi, a wireless communication technology that uses light to transmit data. Unlike traditional radio-based communication systems, Li-Fi operates reliably underwater, making it an ideal choice for maintaining a connection between the diver and the surface. The primary objective of this system is to continuously monitor the diver's vital signs, including heart rate, oxygen levels, and body temperature. This real-time health data transmission allows for instant awareness of the diver's well-being during their under water expedition. However, the true innovation lies in the system's response to abnormal health situations. In cases where the diver's health parameters deviate from the norm in a potentially dangerous manner, the system triggers a rapid and proactive response. This response takes the form of an air balloon that is carried by the scuba diver. When an abnormal health situation is detected, the air balloon swiftly inflates and rises to the surface. Li-Fi (Light Fidelity) is a wireless communication technology that uses light signals to transmit data. In our system, Li-Fi is employed to enable high-speed data transmission from the diver's equipment to the surface, ensuring rapid updates on the diver's status. This technology is reliable and avoids electromagnetic interference underwater.

This ingenious "popout" mechanism ensures the diver's safe ascent, avoiding potential risks associated with underwater emergencies. Simultaneously, the system notifies the receivers on the surface of the situation. The surface receivers are equipped to provide immediate alerts, enabling a swift response to the diver's condition. This dual approach - immediate ascent and surface-side notification significantly enhances the safety of scuba divers, reducing the risk of injury or fatality in challenging underwater 3 environments .To further enhance safety, a Panic Switch is integrated into the system. Divers can activate this switch when facing imminent danger or distress. When pressed, it triggers an immediate alert, prompting a coordinated response from the monitoring team and nearby vessels. The Scuba Divers Health Monitoring System off ersnumerous benefits, including enhanced safety for scuba divers, reducing the risk of accidents and health related issues. Real-time monitoring and data collection for research and analysis, Rapid response in emergency situations, potentially saving lives, Peace of mind for divers and their families.

II. 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.
- Scuba diving is popular recreational activity, but it comes with inherent risks, including equipment malfunctions, underwater navigation challenges, and potential emergencies. The need for communication, especially in emergency situations, is critical for the safety of scuba divers.
- In emergency situations, the lack of efficient communication can lead to delays in response time, potentially jeopardizing the safety of divers. Quick and effective emergency response systems are crucial for scuba diving safety.
- Traditional communication methods, such as radios, are ineffective underwater due to the low penetration of electromagnetic signals. This lack of real-time communication makes it challenging for divers to coordinate actions or seek assistance during emergencies.

III. Objective

1. Develop a real time monitoring system that can continuously and accurately monitor the vital signs of scuba divers, including heart rate, oxygen levels, and body temperature in real-time. Ensure the reliable transmission of health data from the diver to the surface using Li-Fi technology, even in challenging underwater conditions.
2. Implement a robust algorithm to detect deviations from the diver's normal health parameters, signaling potential abnormal health situations. Trigger immediate responses when such abnormal health situations are identified, reducing the risk to the diver.
3. Design and integrate an emergency response mechanism where air balloon system carried by the scuba diver ,capable of rapid inflation and ascent to the surface in response to detected abnormal health situations. Ensure the safety of the diver during the ascent and minimize the potential risks associated with underwater emergencies.
4. Develop Surface-side Immediate Alerts that can receive alerts and notifications in real-time when an abnormal health situation is detected, ensuring that the surface team is immediately informed. Enable the surface team to initiate a swift and effective response to assist the diver in distress .durability.

IV. METHODOLOGY

The IR-based scuba safety system's development entails rigorous steps: defining system requirements including range, encoding, and security; selecting components like IR transmitters, Atmega328 microcontrollers ,and keyboards; designing circuitry; establishing transmission protocols and acknowledgment mechanisms. Simulated underwater tests validate its efficiency and reliability in message delivery. Optimizations fine-tune the system for enhanced performance. Critical security measures, including encryption, safeguard sensitive transmissions. Overall, this systematic approach aims to create a cost-effective, reliable, and secure wireless communication solution for underwater environments.

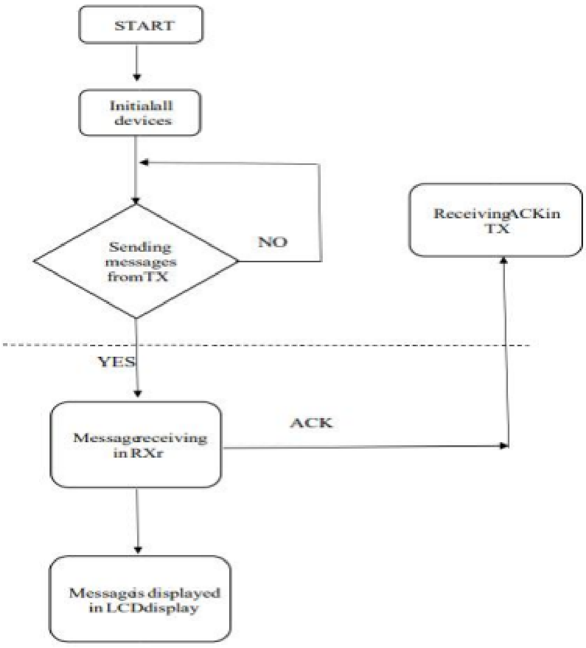

Figure 4.1.1:- Flow chart

4.1 Transmitter Side

1. Arduino Setup: Set up the Arduino board as the main controller for the transmitter side. Connect the pH sensor, turbidity sensor, temperature sensor, and an LCD display to the Arduino.
2. Sensor Calibration: Calibrate the pH sensor, turbidity sensor, and temperature sensor according to the manufacturer's instructions to ensure accurate readings in the underwater environment.
3. Data Acquisition and Processing: Develop code to read sensor data from the pH sensor, turbidity sensor ,and temperature sensor. Process the sensor data to prepare it for transmission, such as converting analog readings to digital values and applying any necessary scaling or filtering.
4. LiFi Transmitter: Integrate a LiFi transmitter module with the Arduino to modulate the sensor data onto light signals. Use a high-intensity LED as the light source for transmitting data. Modulate the LED intensity or frequency based on the sensor readings.
5. LCD Display: Display real-time sensor readings on the LCD display connected to the Arduino. Update the display with new sensor data periodically.

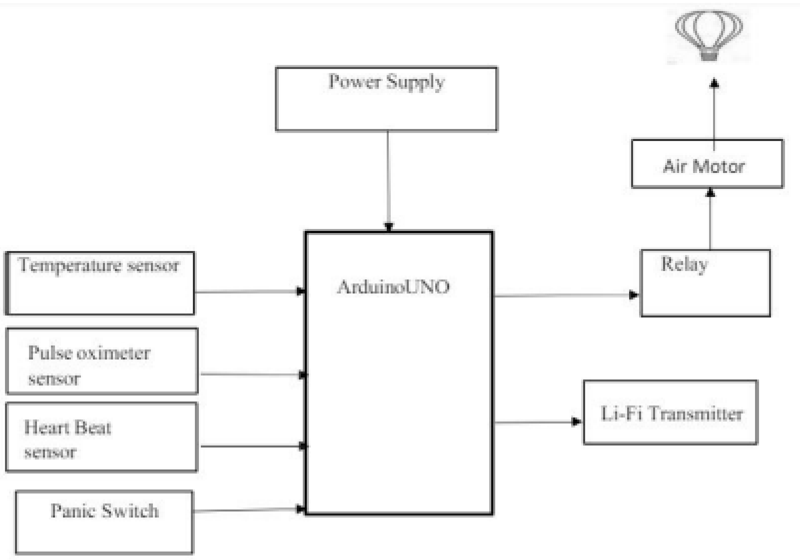

Figure 4.1.2:- Block diagram of Transmitter Side

4.2 Receiver Side

1. Arduino Setup: Set up another Arduino board as the main controller for the receiver side. Connect an LCD display to the Arduino for displaying received sensor data.
2. LiFi Receiver: Integrate a LiFi receiver module with the Arduino to receive modulated light signals transmitted by the transmitter side. Use a photodiode or phototransistor to detect the modulated light signals underwater.
3. Data Decoding: Develop code to decode the received light signals and extract the sensor data transmitted by the transmitter side. Implement error checking and correction algorithms to ensure data integrity in the presence of noise or signal attenuation underwater.
4. LCD Display: Display the received sensor data on the LCD display connected to the Arduino. Update the display with new sensor data received from the transmitter side.

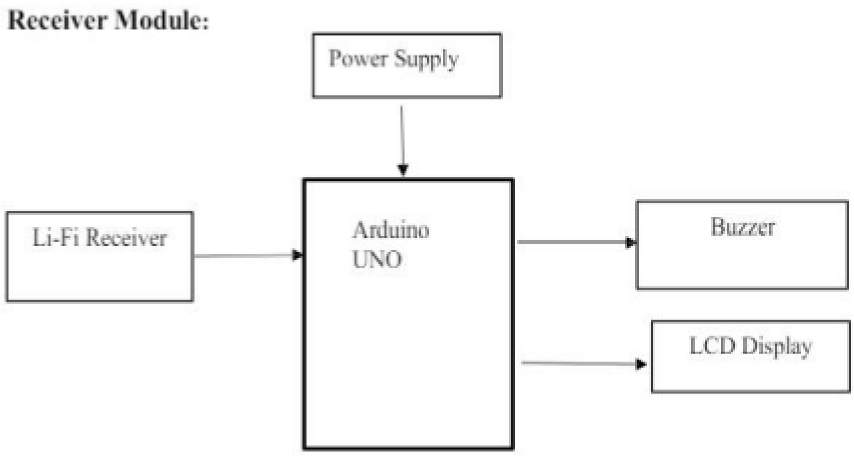

Figure 4.1.3:- Block diagram of Receiver Side

V. RESULTS AND DISCUSSION

5.1. Hardware Testing

5.1.1. Continuity Test

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

This test is the performed just after the hardware soldering and configuration has been completed. This test aims at finding any electrical open paths in the circuit after the soldering. Many a times, the electrical continuity in the circuit is lost due to improper soldering, wrong and rough handling of the PCB, improper usage of the soldering iron, component failures and presence of bugs in the circuit diagram. We use a multi meter to perform this test. We keep the multi meter in buzzer mode and connect the ground terminal of the multi meter to the ground.

5.1.2. Power On Test

This test is performed to check whether the voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode. Remember that this test is performed without microcontroller. Firstly, we check the output of the transformer, whether we get the required 12 v AC voltage.Then we apply this voltage to the power supply circuit. Note that we do this test without microcontroller because if there is any excessive voltage, this may lead to damaging the controller. We check for the input to the voltage regulator i.e., are we getting an input of 12v and an output of 5v. This 5v output is given to the microcontrollers' 40th pin. Hence we check for the voltage level at 40th pin. Similarly, we check for the other terminals for the required voltage. In this way we can assure that the voltage at all the terminals is as per the requirement.

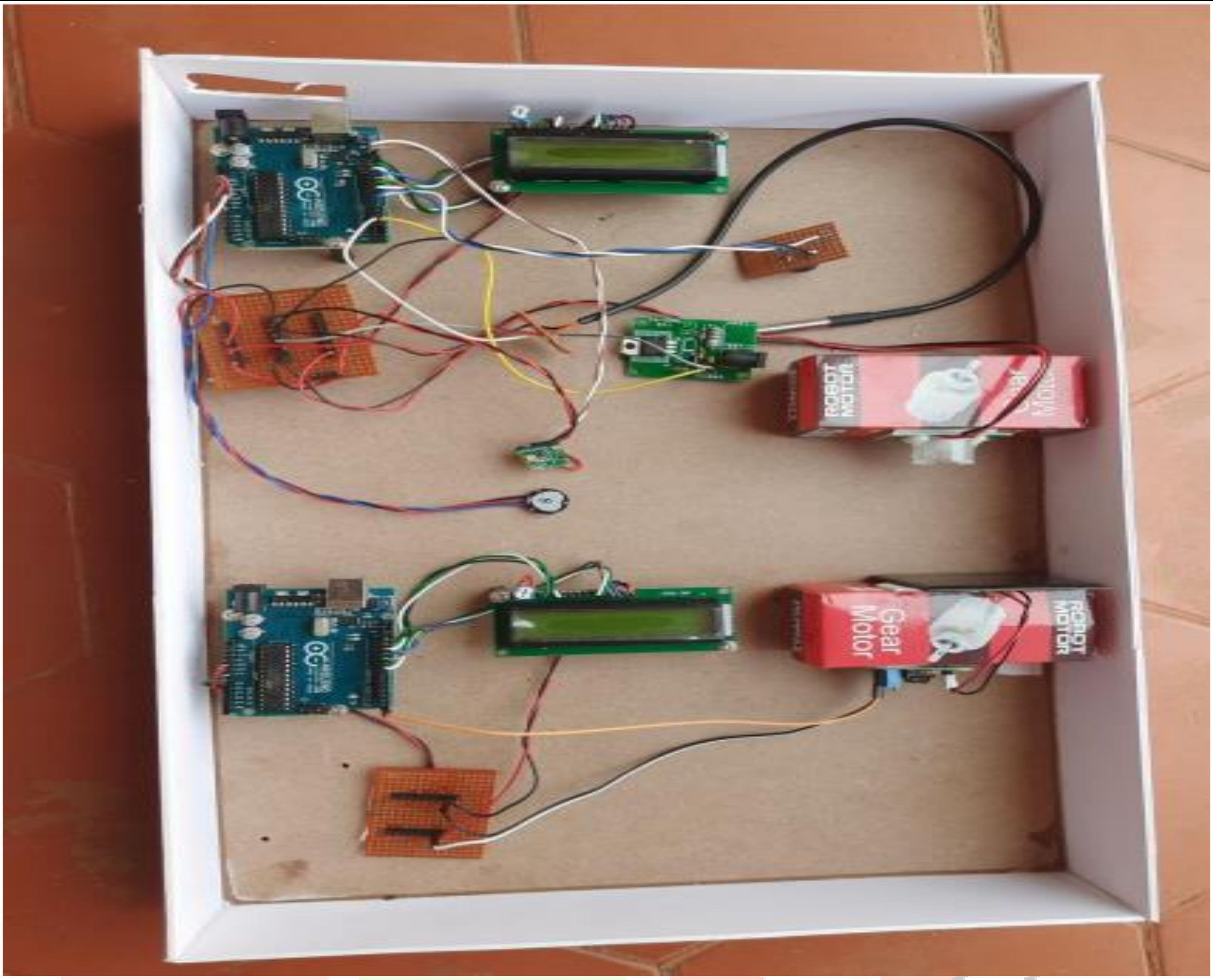

Fig 5.1 Hardware testing

VI. 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.

VII. FUTURE SCOPE

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 them ain technical aspects and research challenges of wireless underwater communication.

REFERENCES

[1] C. Pontbriand, N. Farr, J. Ware, J. Preisig, and H. Popenoe, "Diffuse high-bandwidth optical communications", Oceans 2008. IEEE, 2008.
[2] H.G. Rao, C.E. Devoe, A.S. Fletcher, I.D. Gaschits, F. Hakimi, S.A. Hamilton, et al., "Turbid-harbor demonstration of transceiver technologies for wide dynamic range undersea laser communications", Oceans2016.IEEE, 2016.
[3] Zhang, L., H. Wang and X. Shao, "Improved m-QAMOFDM transmission for underwater wireless optical communications". Optics Communications, vol. 423: pp. 180-185, 2018.
[4] D. Stramski, A. Bricaud, and A. Morel, "Modelling the inherent optical properties of the ocean based on the detailed composition of the planktonic community". Appl Opt., vol. 40, pp. 2929-2945, 2001.
[5] Jaruwatanadilok, S., "Underwater Wireless Optical Communication Channel Modelling and Performance Evaluation using Vector Radiative Transfer Theory". IEEE Journal on Selected Areas in Communications, vol.26(9): pp. 1620-1627, 2008.
[6] Sahu, S.K. and P. Shanmugam, "A theoretical study on the impact of particle scattering on the channel characteristics of underwater optical communication system", Optics Communications, vol 408(SI): pp. 3-14, 2018.
[7] Stojanovic M and Preisig J. Underwater acoustic communication channels: propagation models and statistical characterization. IEEE Common Mag 2009; 47(1): 84–89.
[8] Kilfoyle D and Baggeroer A. The state of the art in under water acoustic telemetry. IEEE J Ocean Eng 2000;25(1): 4–27.
[9] Kaushal H and Kaddoum G. Underwater optical wireless communication. IEEE Access 2016; 4: 1518–1547. [10] Zeng Z, Fu S, Zhang H, et al. A survey of underwater optical wireless communications. IEEE Commun SurvTut 2017; 19(1): 204–238