International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 3 Volume No.8May - June – 2024
DOI:10.46647/ijetms.2024.v08i03.053 ISSN: 2581-4621

UNDERWATER COMMUNICATION DEVICE USING ZIGBEE

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Abstract:
Zigbee is a wireless network protocol that has several advantages over other technologies. Almost no other systems to watch the health conditions of a sea navigator while navigating the sea. while there is a wearable device for monitoring his/her pulse for him/her. But an individual within the ground cannot find about the health conditions of person underwater.
To, overcome this problem, we develop UNDERWATER COMMUNICATION DEVICE USING ZIGBEE. This might be equipment intended for this purpose, or other purposes which is found to be suitable for diving use underwater wireless communication system comprising first and second communications modules which transmit and receive data utilizing infrared radiation.
Which is capable of monitoring the health parameters of the person such as heartbeat, SPO2 and temperature and also activates the buzzer if the sensor data exceed threshold value.
KEYWORDS: Arduino uno Micro-controller, ZIGBEE, LCD display, Embedded C language.

I. INTRODUCTION

Information transformed over a long distance without any means like wires, cables and other forms of conductors. The term wireless communication is broad which incorporate different forms of communication and connecting between more devices without any mode of wires through this wireless communication technology. In pre-industrial age, the first network of wireless was developed. This technology has more advanced and featured with upcoming technology and this is one form is future generation. This technology has more impact in growing world. The name wireless communication itself gives the meaning without any physical connection the communication is done in better way. Wireless communication has exponential growth in cellular system and over around two to three billion users.
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 paper aims in designing a ZIGBEE Wireless Underwater Communication System which is capable of monitoring the health parameters of the person such as heartbeat, spo2 and temperature and also activates the buzzer if the sensor data exceed threshold value. To achieve this task micro-controller loaded program written in embedded C language.
The main controlling device of the paper is Arduino uno micro-controller. MAX30100(heartbeat and spo2), Temperature sensor, Zigbee Transmitter, Buzzer, LCD display and panic switch is interfaced to the micro-controller. Micro-controller will continuously read the data from sensors will be display on LCD module. Monitoring section: ZigBee receiver, LCD display, Buzzer is interfaced to the Arduino uno micro- controller.
Underwater communication is a critical field with applications ranging from environmental monitoring and underwater exploration to military operations and commercial activities such as oil

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and gas extraction. Traditional wireless communication methods, which rely on radio waves, face significant challenges underwater due to the high attenuation of these signals in water. This necessitates the development of specialized technologies for effective underwater communication.

Zigbee: An Overview :

Zigbee is a specification for a suite of high-level communication protocols using low-power digital radios based on the IEEE 802.15.4 standard. It is designed for applications that require secure, low-cost, low-power, and reliable wireless networks. Zigbee is commonly used in home automation, industrial control, and other applications requiring short-range communication and low data rates.

Applying Zigbee in Underwater Communication :

While Zigbee is traditionally used for terrestrial applications, its adaptation for underwater communication presents an innovative solution to some of the challenges faced by conventional underwater communication systems. Here are the key aspects of using Zigbee for underwater communication:

Low Power Consumption:

One of Zigbee's primary advantages is its low power consumption, which is crucial for underwater devices that often rely on battery power. Long operational periods without frequent battery changes are essential for underwater monitoring systems.

Mesh Networking:

Zigbee supports mesh networking, which allows multiple devices to communicate with each other, extending the communication range and enhancing reliability. In an underwater setting, this can help create a network of sensors or devices that can relay information to a central hub.

Data Rates and Range:

Zigbee offers moderate data rates suitable for many underwater applications, such as environmental monitoring where data size per transmission is relatively small. The typical range of Zigbee in air is about 100 meters, but underwater, this range is significantly reduced due to the absorption and scattering of signals by water. Nevertheless, for short-range communications within underwater environments, Zigbee can be effective.

II. PROBLEM STATEMENT

Nowadays people are very much interested in adventures like diving in to the sea , finding some important treasure that could become an asset to the government.

In order to fulfill there desire they travel under the water.They face difficult situations naturally and mentally sometimes.

Their health condition may become worse due to some technical and mental conditions as they dive deep in to the sea.

III. LITERATURE SURVEY

Tittle: Underwater Electric Field Communication System Based on Zigbee.

Feilong Li; Shengping Zhao; Lin Xu; Tianyang Xu; Peisong Jia; Wenjian Chen

Concept: underwater electric field communication system based on ZigBee technology,the system introduces ZigBee technology to realize the underwater communication network. Each ZigBee module is connected to a Universal Software Radio Peripheral (USRP) for data interaction. The system has the characteristics of low cost, low power consumption, flexible configuration and wide coverage.

Merits: 1.revealed that up to 90% of faults on most overhead lines are transient, ranging from 70% to 90%

2.When one or more circuit breakers tripped to isolate a problem, such as an router flashover, the fault is cleared and does not reoccur.

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Tittle:" : Technical Analysis of ZigBee Wireless Communication
Author: Sujan Shrestha : Subarna Shakya
Concept: Information transformed over a long distance without any means like wires, cables and other forms of conductors. The wireless communication is broad which incorporate different forms of communication and connecting between more devices without any mode of wires through this wireless communication technology.
In pre-industrial age, the first network of wireless was developed. This technology has more advanced and featured with upcoming technology and this is one form is future generation. This technology has more impact in growing world.
The name wireless communication itself gives the meaning without any physical connection the communication is done in better way. Wireless communication has exponential growth in cellular system and over around two to three billion users.
Merits: 1.The Internet of Things can be used to the current status of the security issue and to switch off the electricity and control the home appliances.

Tittle: "Underwater Robot With Wireless Communication Module.
Author: Neelam R. Sattur, Parina K.N, Pushpanjali S.
Concept: from this we can understand that there is an specific modules used for the communication of underwater information through Zigbee.
Merits: 1.The system uses an specific module for the designed algorithm approach to detecting, analysing, and classifying problems.

Tittle: "Zigbee Wireless Underwater Communication system"
Author: G. Nagendra , Mohammed Zahoor Ul Haq Riyan , Chethula Priyanka M , Dudekula Iliyaj , Kalakonda Rajshekhar Reddy.
Concept: This method will assist to monitor the health conditions of persons who dive in to the sea. A variety of devices are employed in this system, including a GSM modem, sensors.
2.This system can work in different directions to transmit or receive the information is send to the service provider company .

Tittle: Wireless Underwater Mobile Robot System Based on ZIGBEE
Author:Mofeed Turky Rashid, Abduladhem Abulkareem Ali, Ramzy Salim Ali, Luigi Fortuna
Concept: It is designed to study the behaviour of Artemia group, using Zigbee**.** A new idea has been presented for underwater mobile robot system which is consists of two parts, first is the underwater mechanical robot and the second is ZigBee wireless based mobile robot which controls and moves the first part. By this system different patterns motion control (Linear, Circular, Zigzag, etc.) has been performed and proved the ability to control group of robot by controlling the group of Artemia.
Merits: 1. Operational of collective behavior of animals have been a source of inspiration for multi-agent control strategies based on decentralized algorithms.
2. The notification will be conveyed by zigbee if there is any change in the temperature.

IV. IMPLEMENTATION
To demonstrate how a Zigbee device works with MAX30100 (a pulse oximeter and heart-rate sensor) and DHT11 (a temperature and humidity sensor), and how the XCTU application can be used to configure and manage this setup, let's break down the process into the following steps:
1. Hardware Setup
2. Zigbee Configuration Using XCTU

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3. Interfacing Sensors with Microcontroller
4. Data Transmission Using Zigbee
5. Monitoring Data with XCTU

1. Hardware Setup

Components Required:

- Zigbee modules (e.g., XBee Series 2)
- Microcontroller (e.g., Arduino, ESP32)
- MAX30100 sensor
- DHT11 sensor
- Power supply
- Connecting wires

Connection Overview:

- Connect the MAX30100 and DHT11 sensors to the microcontroller.
- Connect the microcontroller to the Zigbee module via UART (TX/RX) pins.
- Ensure proper power supply and ground connections for all components.

2. Zigbee Configuration Using XCTU

Step-by-Step Configuration:

1. Connect the Zigbee Module to Your Computer:
   - Use a USB-to-serial adapter if necessary.
   - Open XCTU and detect the connected Zigbee module.
2. Configure Zigbee Network:
   - Set up one Zigbee module as the Coordinator and others as Routers or End Devices.
   - Coordinator Settings:
     - Set PAN ID (e.g., 1234).
     - Set the Channel (e.g., C).
   - Router/End Device Settings:
     - Use the same PAN ID and Channel as the Coordinator.
     - Configure destination address to the Coordinator's address.
3. Communication Parameters:
   - Set the baud rate (e.g., 9600 bps) to match the microcontroller’s serial communication settings.
   - Configure the sleep settings if needed (for power-saving purposes).
4. Write Configuration:
   - Save and write the configuration to the Zigbee modules.

3. Interfacing Sensors with Microcontroller

4. Data Transmission Using Zigbee

- **Serial Communication**: The microcontroller sends the sensor data via its serial interface to the connected Zigbee module.
- **Zigbee Transmission**: The Zigbee module transmits the data wirelessly to the Coordinator module.

5. Monitoring Data with XCTU

Steps:

1. Connect Coordinator to XCTU:
   - Use a USB-to-serial adapter if necessary.
   - Open XCTU and detect the Coordinator module.
2. Open Console Mode:

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- Switch to the Console mode in XCTU.
- Open a serial connection to the Coordinator.

3. Monitor Incoming Data:

- The Console mode will display the incoming data from the End Device (connected to sensors via the microcontroller).
- You can observe real-time sensor data updates (temperature, humidity, heart rate, and SpO2 levels).

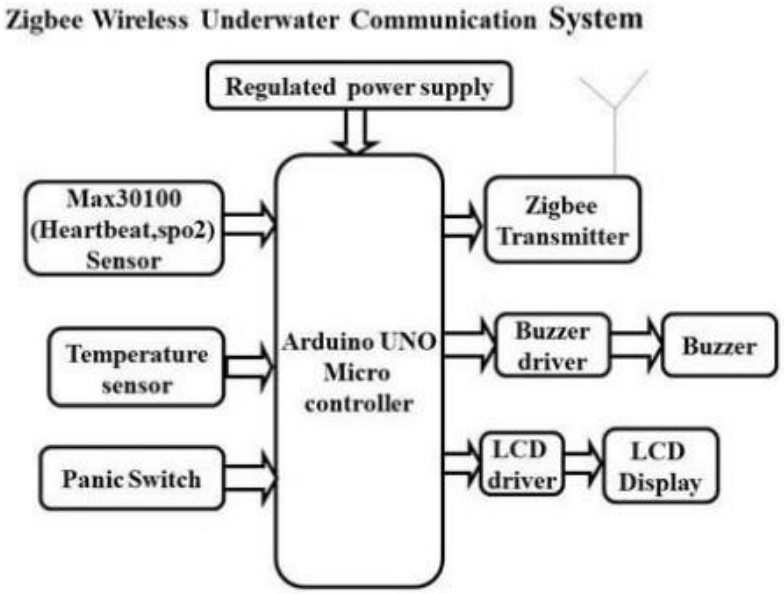

Fig 1 Transmitter Section Block Diagram

V. RESULTS

XCTU is a software tool provided by Digi International that allows you to configure, manage, and test XBee RF modules. When you run XCTU and collect results from a test or configuration session, the data can be quite extensive. Here's a detailed explanation of the typical results you might encounter in XCTU, which you can use for report writing:

Displays all detected parameters in the series.

Human-readable identifier assigned to each node.

Short address assigned to each node within the network.

Indicates the signal strength received from each node, useful for determining link quality.

Shows which node a device is connected to in the network hierarchy.

Range Test: Measures the signal strength and packet success rate between two nodes over a distance.

- **Packets Sent/Received:** Number of packets sent and successfully received.
- **Success Rate:** Percentage of successfully received packets.
- **RSSI Values:** Signal strength values for the transmitted packets.

Throughput Test: Measures the data transfer rate between nodes.

- **Data Rate:** Speed at which data is successfully transmitted.
- **Packet Loss:** Number or percentage of packets that failed to be received.

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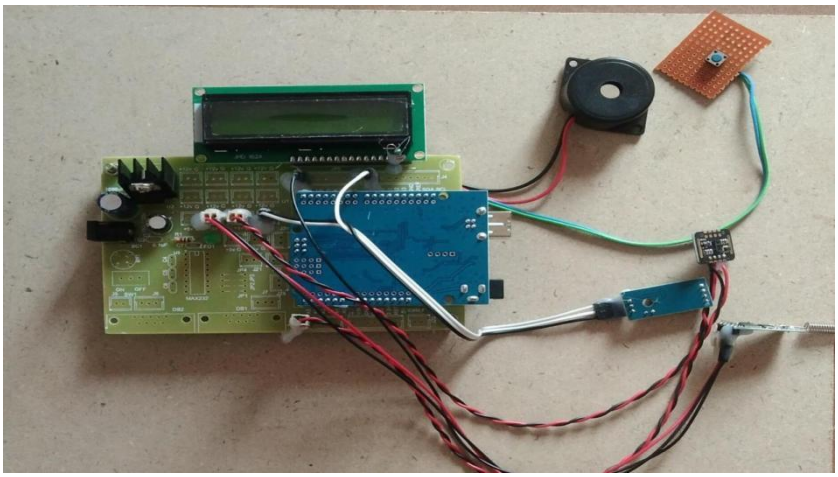

Fig 2: 1Result

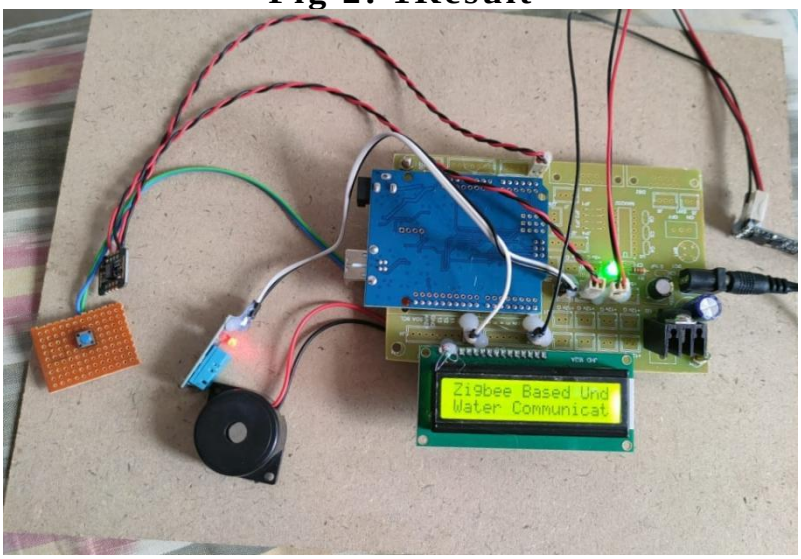

Fig3: 2Result

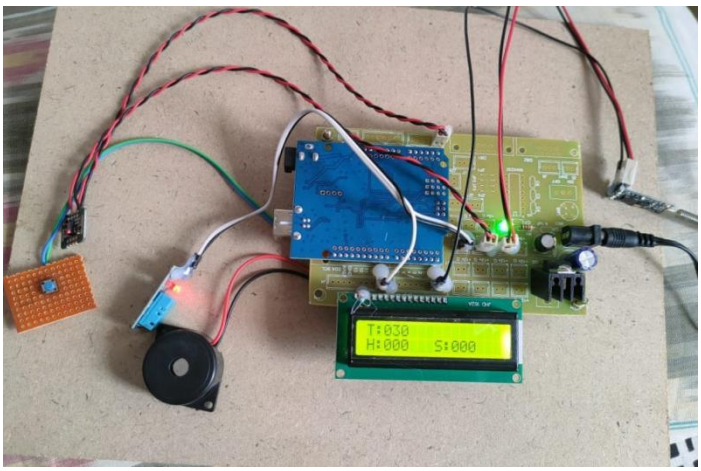

Fig4: 3Result

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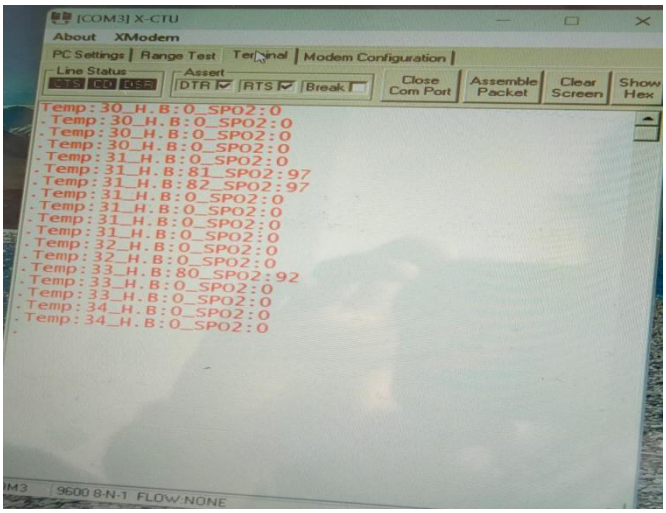

Fig5: Output Result

VI. CONCLUSION

While the use of Zigbee for underwater communication is fraught with challenges primarily due to signal attenuation and environmental interferences, careful design and optimization can yield functional systems for specific applications. The analysis and data provided by XCTU are instrumental in understanding the limitations and potential of Zigbee in this unique context. Continued research and development, including potential hybrid systems that combine Zigbee with other communication technologies, are essential for advancing the effectiveness of underwater wireless communication networks.

The use of Zigbee technology for underwater communication, while challenging due to the physical properties of water, offers promising avenues for specific applications that can benefit from wireless sensor networks. Detailed analysis using XCTU data highlights the critical aspects of signal attenuation, hardware adaptations, and performance metrics that must be addressed. By optimizing configuration parameters and exploring hybrid communication solutions, it is possible to develop effective underwater communication systems leveraging Zigbee technology. Continued research and development will further enhance the viability and performance of these systems, opening new frontiers in underwater monitoring, management, and exploration.

VII. FUTURE SCOPE

The future scope of the underwater communication system using Zigbee encompasses several avenues for advancement and application. As technology evolves and research progresses, there are numerous opportunities to enhance the capabilities and expand the potential of this communication system.

The underwater communication systems using Zigbee is expansive, with numerous opportunities for innovation and improvement. Advanced hardware development, hybrid communication systems, optimized network protocols, enhanced energy efficiency, and robust software tools are key areas that will drive the evolution of this technology. By addressing the current challenges and exploring new applications, underwater Zigbee communication systems can become a cornerstone of marine research, environmental monitoring, and industrial automation, contributing to the sustainable and efficient management of underwater environments.

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