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# Underwater Energy Efficient Wireless Voice Transfer and Tsunami Detection System

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**Abstract** — From the past decades we are experiencing a growing interest in the field of underwater energy efficient communication .Some of the applications are marine research, oceanography, marine commercial operations, defense etc. There had been a great development in this field due to continuous research from many years. In this paper we provide key points of underwater energy efficient communication and its application like voice transfer and Tsunami detection system. We also provide information about challenges faced in this field now and in near future.

**Keywords— Underwater Communication, Wireless, voice transfer, Tsunami Detection System**

## INTRODUCTION

From the past decades we are experiencing a growing interest in the field of underwater energy efficient communication .Some of the applications are marine research, oceanography, marine commercial operations, defense etc. There had been a great development in this field due to continuous research from many years. In this paper we provide key points of underwater energy efficient communication and its application like Tsunami detection system. We also provide information about challenges faced in this field now and in near future. A series of review papers provide an excellent history of development in this field. In this paper we aim to provide an overview of energy efficient underwater communication. We also hope to provide open field challenges faced by researchers in this field.

The earth is a water planet. Oceans cover about two-third of the surface of Earth. A growing trend has been observed in monitoring aqueous environments like oceans, rivers, lakes, ponds and reservoirs for scientific exploration, exploitation for commercial purpose and protection from natural disasters such as Tsunami. For this type of extensive monitoring, a networked underwater wireless sensor distributed system called the Underwater Wireless Sensor Network (UWSN) is used. Communications techniques originally developed for terrestrial wired and wireless channels need significant modifications to suit underwater communication. A series of review papers provide an excellent history of the development in this field. In the past, underwater exploration relied on either a single high-cost underwater device or a small-scale underwater network.

The existing technology was not suitable to applications covering a wide area. Underwater Wireless Sensor Network (UWSN) is a scalable wireless sensor network in 3D underwater space that employs sensors to monitor and detect environmental events locally. A mobile UWSN when compared to ground-based sensor networks had to employ acoustic communication. Acoustics provide a better medium to enable underwater communication as electromagnetic waves propagate poorly in underwater environment,. The mobile UWSN was different from the small-scale existing UAN (Underwater Acoustic Network) in terms of scalability, self-organizing and localization of the mobile sensors. Underwater sensor networks enable a wide range of aquatic applications, such as oceanographic data collection, pollution monitoring, offshore exploration, and tactical surveillance applications. Today, a number of manufacturers including Teledyne and LinkQuest in the U.S and Evologics in Europe provide commercial acoustic communication systems.

Underwater communications are based on acoustic links characterized by large propagation delays. Incoherent modulation methods were used for simplicity and reliability in most early underwater acoustic communication. Most of the new advances in the past decade have been in the area of coherent communications. Coherent communications have been advanced by DFE (Decision Feedback Equalizer) algorithms which have enabled underwater communication channels to be equalized.

An underwater network is typically made up of many autonomous and individual sensor nodes. These nodes perform data collection operations as well as store and forwarding operations to route the data that has been collected to a central node. The cost, the computational power, the memory, the communication range and most of all the limited battery resources of each individual sensor node are the major challenges for deploying such a network. Acoustic channels have low bandwidth which results in the very high bit error rates of acoustic links and a high rise in connectivity losses. There are various other challenges like path loss, noise, absorption of high frequency sounds by sea water, multipath and Doppler Spread.

In this project, the idea is to transmit both voice and data using water as a source. To make it energy efficient, Solar Panels are being used to provide energy. A Piezoelectric Crystal will be installed on both the transmitting and receiving end which will sense the seismic vibrations and will also help in the transfer of voice.

The idea of this project is to develop such a cost effective system that will be able to monitor underwater activities and produce correct data. The mode used is continuous transmission where one user is transmitting continuously.

This research paper is divided in two sections: wireless voice transfer and Tsunami Detection system.

## I. WIRELESS VOICE TRANSFER

Underwater wireless communication is a topic of research and is continuously being explored for new methods and approaches. The question here arises is that what is the need of using water as a medium and providing communication? Underwater communication is a new technology and can be used to replace satellite across water bodies. It can be made cost effective and has many deep sea underwater applications like oceanographic data collection, pollution monitoring, offshore exploration, and tactical surveillance applications. For underwater acoustic communication, the idea is to use a Piezoelectric Crystal which is a crystal that can be used as a transducer to convert the sound/voice signals into vibrations. These transmitted vibrations will be amplified by an OP-AMP and received by another piezoelectric crystal and then again reconverted into sound/voice signals at the receiver end.

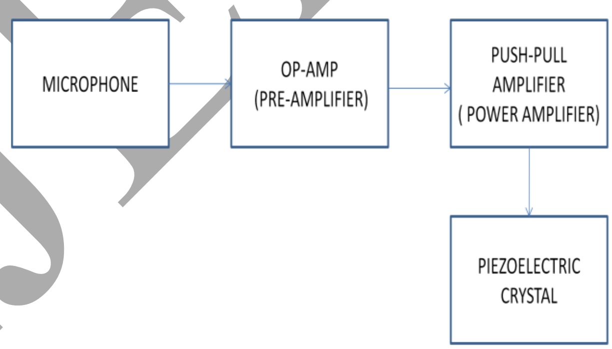
The mode of communication will be one way line of communication where one user is transmitting continuously. In this mode all audible noise (speech, breathing, grunts, etc.) will be heard by others on the same channel and within range.

**A. TRANSMITTER SECTION**

In the transmitter section of voice transfer, a piezoelectric crystal is being used. When we speak or talk, the voice creates vibrations over the mike, as the mike is also a type of piezocrystal, it converts voice vibrations into electrical signals. There is a resistor which acts as a voltage divider. The electrical signal is applied to the OP-AMP IC 741 for amplification. The output from the OP-AMP is given to push pull amplifier for power amplification. Then the output of push pull amplifier is passed to the piezocrystal which again converts the electrical signal into mechanical vibrations which travels through water using it as a medium and reaches the receiver part.

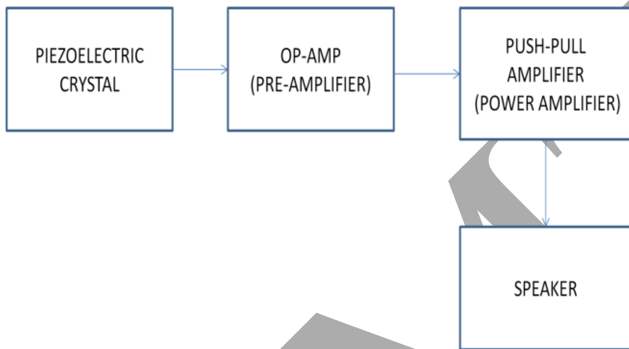
The major difficulty in deploying UWSN is energy efficiency. In case of terrestrial sensor networks battery failure can be identified easily and replaced easily but in case of underwater sensor networks frequent replacement of battery is tedious, hence the battery lifetime should be maintained for long period. A new transmission scheme with short delay and high energy efficiency is desirable for time critical applications in underwater sensor networks.

Natural disasters are something which a man can't control because it is created by nature and will be destroyed by nature. As we have seen throughout the history, there have been natural disasters and it has left its effect on the human being either good or bad. Numerous enquiries have been asked about the possibility of Tsunami occurring in coastal areas, the extent to which these areas are currently monitored to detect Tsunamis and if there is a National capacity to issue evacuation warnings. These concerns are stemmed from the December, 2004 Tsunami triggered by an underwater earthquake in the northern part of Indonesia. Though there were many proposals to monitor Tsunami, only few networks are working and only few areas are covered.




**B. RECEIVER SECTION**

The piezoelectric crystal works as a inductor it stores the magnetic field, due to this property of piezoelectric crystal can transfer energy. Piezoelectric crystal receives vibrations from the transmitter section. Resistors (R1 and R3) of 4kohm are used maintain the energy of the received signal. Capacitor C1 (0.1 micro farad) is used to block the dc component and passes the ac component in the circuit. Then the signal passes through potential divider which consists of resistors(R2,R4) of 10 KOHM which is used to provide specified amount of signal to the amplifier(OP-AMP IC741) which then amplifies the signal then the output of the OP-AMP is fed to the push pull amplifier to amplify the power of the received signal. Push pull amplifier consists of two transistors PNP and NPN (no 54 and no 68).The output of the push pull amplifier is given to capacitor which again blocks the dc signal and passes the ac signal. The output of capacitor is fed to the speaker .Thus we receiver our output.



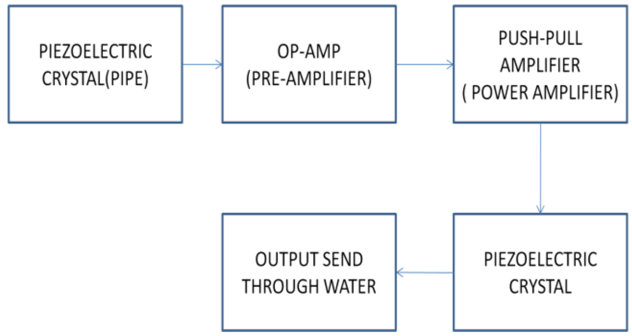

**II. TSUNAMI DETECTION SYSTEM**

The idea of implementing underwater sensor networks to monitor disasters like Tsunami has been discussed for the safety of human lives. Numerous enquiries have been asked about the possibility of Tsunami occurring in coastal areas, the extent to which these areas are currently monitored to detect Tsunamis and if there is a National capacity to issue evacuation warnings. Our research explores the idea to monitor disasters using small sensors. To have small devices distributed being sensed brings new opportunities to observe the environment where it is impossible for human to reach and brings new idea to explore the underwater world. Being able to monitor natural disasters gives us opportunity to be saved by the destruction caused by it. With the help of sensor technology the disasters can be monitored but can't be prevented. We can use the records to reduce the effects of destructions and give early warnings.

For Tsunami Detection, a Piezoelectric Crystal will be installed underwater. It will sense the vibrations and using water as a source we will send it to other end.

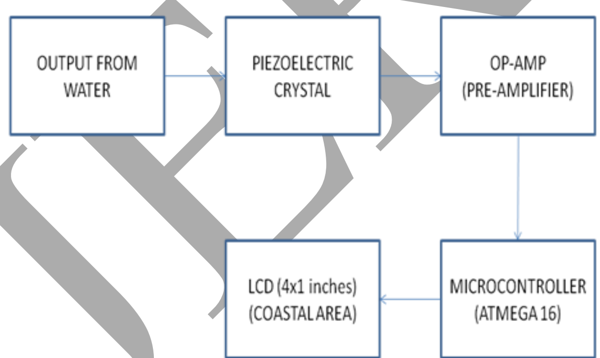
**A. TRANSMITTER SECTION**

In the transmitter section of tsunami detection system, a piezoelectric crystal is being used. Here instead of voice, input data will be the vibrations from water. The electrical signal is applied to the OP-AMP IC 741 for amplification. The output from the OP-AMP is given to push pull amplifier for power amplification. Then the output of push pull amplifier is again passed to the piezocrystal which again converts the electrical signal into mechanical vibrations which travels through water using it as a medium and reaches the receiver part.

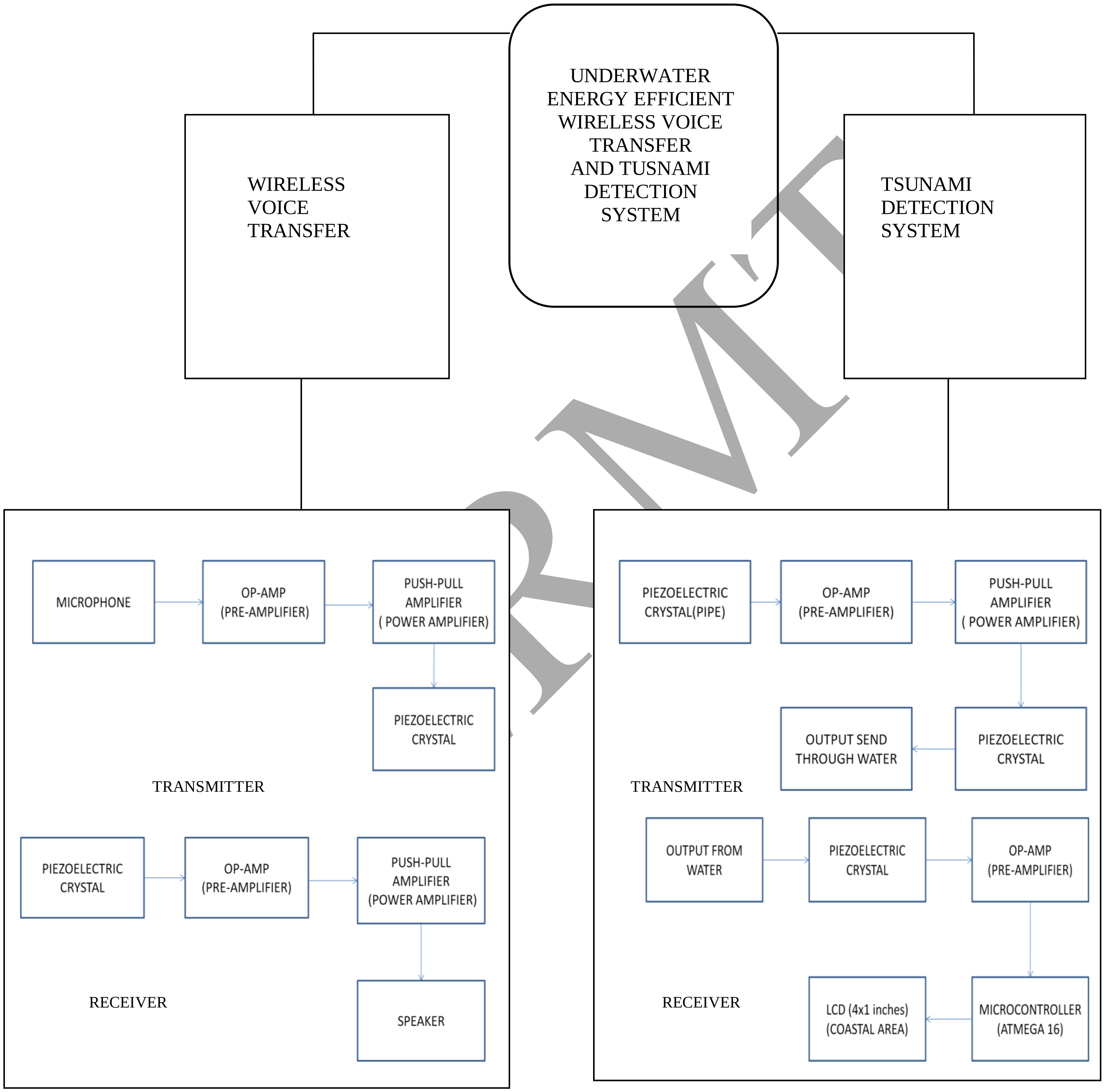



When the mechanical vibrations reach the receiver section, they are received by a piezoelectric crystal which again converts mechanical vibrations into electrical signals. These signals are again amplified using OP-AMP IC 741.Then the output of OP-AMP is passed to a microcontroller Atmega 16. The microcontroller interfaces the received output to a 4x1 inches LCD. The LCD displays the digital output.

**B. RECEIVER SECTION**



**BLOCK DIAGRAM**



**CONCLUSION**

This paper has summarized the ongoing research in underwater energy efficient wireless voice transfer and Tsunami Detection System. We aimed at providing a brief overview of the key developments, both theoretical and applied, regarding the development of our project. We invested our time in studying various previous review papers and researches to get the past and present scenarios of the underwater communication system.

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