**Messaging and Voice for Underwater Systems (MVUS)**

**Project By.**

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***Brief on Solution***

To enhance the underwater communication capability between divers, ships and submarines, there is a requirement for the development of an indigenous Underwater Diver Acoustic Communication Equipment (UDACE) for Marine Commandos. To make the equipment more tactically useful and to enhance the spectrum of operation where it can be utilized, this equipment needs to be compatible with the Base Transceiver Station (BTS) on board submarines/surface ships

Indian Navy is presently using hard-wired mode for diver communication, where the number of communication channels & distance are limited, along with hindrances to movement of diver. A wireless mode of communication provides more flexibility to the diver and ease of deployment. Hence it is required to develop a state-of-the-art wireless Underwater Diver Acoustic Communication Equipment (UDACE) that is compatible with the Base Transceiver Stations (BTS) on-board submarines/surface ships. The current technology used by Indian Army consists of 4 wire to establish a bidirectional communicate. This solution although offers high fidelity communication, still doesn’t stretch to the users needs as the communication range is limited by wire length.

Our solution replaces the use of wire with hybrid light-acoustic means making the communication channel wireless. Our prototype includes the use of a piezo transducer to send information long distances as acoustic waves, while for shortrange communication , light modulation is done and for out of water communication normal rf communication is employed. This hybrid system helps in maintaining a reliable consistent communication channel.

The solution accomplishes the following requirements:

* Easily attachable to any mask
* Is able to fully integrate into an existing diver communication suite
* Equipped with an emergency mode of communication to alert other divers and base stations in case of distress
* A mechanism to measure and communicate the heartbeat of the diver to base stations as a basic health monitoring system
* Use of laryngophone for better Fidelity in communication
* AI controlled feedback system that analyses pitch changes wrt to underwater pressure and corrects voice output accordingly.
* Handsfree Communication
* Hybrid Communication Technology
* Incorporated Radio for Out of water communication.

We have created 3d printed Accessories which can be scaled to injection modelled props which can be attached to most diver suits as needed. The lightweight design enables easy movement freedom for the divers. The onboard pulse rate sensor measures heartbeat and broadcasts it to the base station. Usage of a laryngophone has helped in better fidelity as air based microphones would not work underwater properly due to the variation in pressure with depth, the use of laryngophones avoid air medium and uses sound conducted through the tissues and bones. As a diver goes in deeper his voice will be altered due to the change in pressure , an onboard pressure monitoring system will keep track of the depth of the diver ,with the help of an AI will re adjust the divers vocals to intelligible voice. The diver is connected to everyone simultaneously thanks to handsfree communication ,the diver can chat with anyone like on an interview call. The advanced use of light ,acoustic and rf mediums help in communication under water and out of water ,each technology helps in improving the others fidelity ,The onboard PC samples all the acquired data correlates everything and produces the most accurate results of all.

Our solution is able to provide upto 4hours of usage time with a 3000mah 12V battery. Is estimated to operate upto a depth of 130m in a temperature of 5C.

We offer a Half Duplex communication at large distance (more than 30m) and Full duplex communication within short distances.

We provide three devices as our solution to overcome the problem of underwater communication.

1. RF Buoy
2. Acoustic Repeater
3. MVUS Tranciever

**RF Buoy**

This device floats on top of the sea surface , It is used as a communication bridge between out of water and under water systems, As these can be optionally deployed, the devices can act as mediums that can be used to contact the divers by people out of water such as with boats using normal RF.

**Acoustic Repeater**

Long distance communication through acoustic waves are promising but these do offer attenuation so these signals needs to be amplified. Thus Repeaters needs to be added between the communication path. The job of these devices are to pickup signals and retransmit it above the thermocline. These devices would be able to hold their depth using a pressure controlled feedback loop.

**MVUS Tranciever**

This the heart of the system, this device would be the walkie-talkie attached to the diver. The device will comprise of Light, RF and Acoustic transceivers. Allowing a full duplex communication under and above water. The device would be made such that its operating frequency could be adjusted so as to match the frequency of the submarine to operate on. Features such as heartrate monitoring, Continuous pitch, gain and squinch adjustment using feedback AI’s , Automatic Channel switching will be implemented. The entire communication will happen below 3kbps (kilobits per second) thanks to AI researches on audio codec. All communication will be encrypted using unique RSA keys installed on all devices.

NOTE: Implementation to all the devices has been explained thoroughly in the briefing of technology section. This paper was supposed to give a glimpse of the implementation