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Design of Submarine Monopole Antenna For Data Transmission

V.Hemamalini[1], R. Kimmi Prathesha[2], M. Mano Sumithra[3], P. Nandhini[4]

[1]Assistant Professor, Department of ECE, New Prince Shri Bhavani College of Engineering and Technology, Chennai, India

[234]UG Student, Department of ECE, New Prince Shri Bhavani College of Engineering and Technology, Chennai, India

ABSTRACT: This paper presents a design and implementation of sea-water monopole antenna at very high frequency (VHF) band for submarine wireless data transmission. The sea-water monopole antenna consists of a feeding metal probe and a sea-water cylinder made by a crystal transparent acrylic tube. The feeding metal probe is loaded with a disk on the top to improve the excitation of transverse electromagnetic (TEM) mode.To stimulate the sea water monopole antenna commercial software package such as Embedded C and visual basic are used. The tubular antenna consists of two diameters, the inner diameter is 200mm and the outer diameter is 250mm and 3mm thickness. Measurement shows that the proposed seawater antenna is optically transparent and can be easily reconfigurable.The concept of our project is to transmit the data without using any motors. By using Seawater Monopole Antenna is very efficient and it could be the reliable concept of sending data through salt water using tubular antenna.

KEYWORDS: Radio antenna, monopole antenna and feeding probe.

I. INTRODUCTION

A monopole antenna is a class of radio antenna consisting of a straight rod-shaped conductor, often mounted perpendicularly over some type of conductive surface, called a ground plane. The driving signal from the transmitter is applied, or for receiving antennas the output signal to the receiver is taken, between the lower end of the monopole and the ground plane. One side of the antenna feed line is attached to the lower end of the monopole, and the other side is attached to the ground plane, which is often the Earth. The very low frequency (VLF) transmitting station can be used to provide communication underwater or on water surface with submerged submarines. And it is an important means for submarine command and communications. As the VLF transmitting antenna system has a complex structure and a large size, the radiation field may cause a potential harm on staff as well as to the public [1]. The influence of the feeding methods as well as the length of the probe, and the influence on the radiation efficiency considering the parameters of the materials and the substrates are also under evaluation. This is a preliminary structure built to analyze and evaluate the feasibility of hybrid radiation materials for antennas [2]. The position of the junction unit can be predicted ifthe initial conditions such as water depth, latitude and longitude of the ship, tilt angle of the cable, etc., are provided properly. Some discrepancies exist between the simulation and the measured value. As the main cause ofthis discrepancy, the effect of the initial conditions, namely the initial tilt angle ofthe cable, were pointed out [3]. The center frequency of monopole is tunable by controlling the height of the sea water cylinder, while the bandwidth of the antenna can be adjusted by widening or narrowing the water cylinder. The main features of monopole sea water antenna include its high radiation efficiency, high transparency, low cost and simple structure [4].

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II. STRUCTURE OF THE SEA WATER MONOPOLE ANTENNA

Figure 1 shows the geometry of the sea-water monopole antenna mounted on a ground plane. As shown, in order to hold the sea-water cylinder, a clear acrylic tube is chosen to be vertically fixed on a Teflon base and sealed with silicone gasket. Its transmittance is nearly perfect; therefore it can be used to design an optically transparent antenna. The feeding probe is loaded with an aluminum disk on the top before being mode. To achieve the desired TM mode, the clear acrylic tube and the feed probe are concentric to maintain its structural symmetry. It is clear that the sea-water monopole antenna can bereconfigurable which means that its center frequency and bandwidth can be adjusted by changing the height and radius of the sea-water[4].

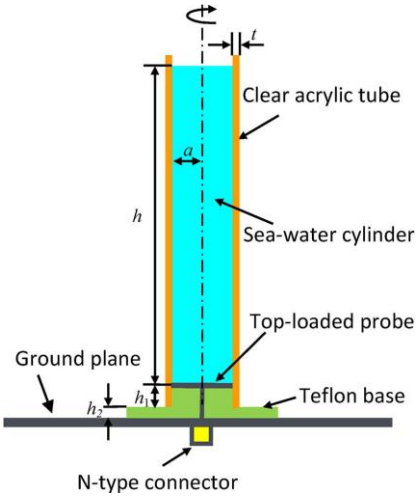

Fig.1. Geometry of the sea-water monopole antenna.

III. METHODOLOGY

In this project four sensors are used to sense various submarine parameters such as engine temperature, turbine temperature smoke, fire .The values that are sensed are displayed at the transmitter side for monitoring purpose of the submarine. If needed, they are sent to another receiver who is supervising the parameters regularly. Instead of providing the set of sensed values to the receiver ,we are providing only the status (normal or abnormal) and there is no further analysis required by the supervisor to distinguish the values within the acceptable range and out of range .In this proposed system a sea water monopole antenna structure is relatively simple, mainly consists of a transparent plastic tube filled with sea-water and a top-loaded feeding probe which is mainly used to transmit the status to the receiver by wireless technique . The circuit receives a 230v A.C. supply. A 12v step-down transformer steps down the 230v to 12v .Now the bridge rectifier converts the A.C. to D.C. The output of the bridge rectifier may contain some component ac component or ripples in it. So a capacitor filter is used to remove the ac component and produce pure dc. An IC7805 voltage regulator is used to regulate the 12v dc to 5v since the circuit operation requires only 5v. The microcontroller use here is PIC 16F877A.The 5v supply is given to the controller. The transmitter side consists of a PIC controller, Signal conditioning circuit , 4 sensors interfaced namely thermocouple sensor, Thermistor sensor, Light Dependent Resistor, IR based sensor that communicates with a PC , RF transmitter module (including RF transmitter and a 4- bit encoder), and Seawater Monopole Antenna.

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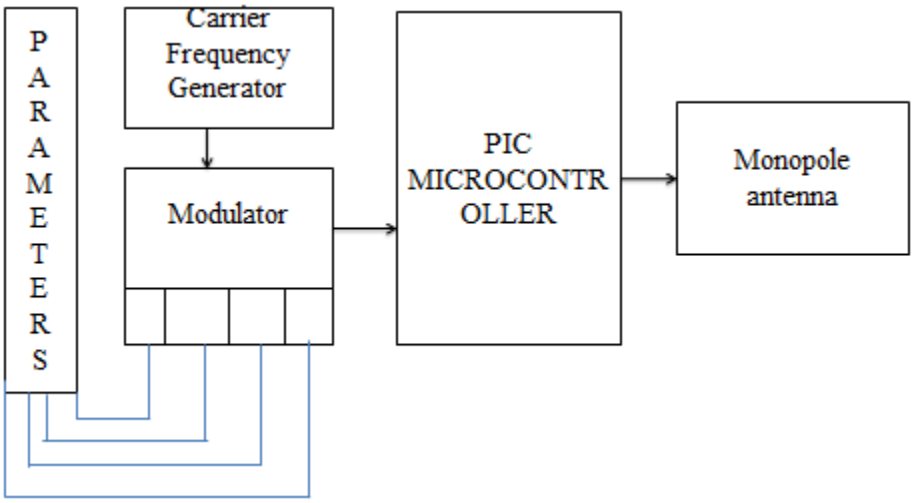

Fig.2. Block diagram of transmission section

On the other hand, the receiver side consists of a PIC controller, RF receiver module (including RF receiver and a 4- bit decoder), that communicate to the PC at the receiver sideThe thermocouple sensor, Thermistor sensor, Light Dependent Resistor, IR based sensor are interfaced at port A of the microcontroller .The sensed outputs are given to the Signal Conditioning circuit in order to amplify the weak signals before reaching to the microcontroller. All these analog inputs given to the controller are converted into digital using ADC present in the controller that operates in 10 bit .The encoder in the RF transmitter module is connected to the data pins and transmission enable pin The RS-232 which is in turn connected to the PC where the values of the thermocouple sensor , Thermistor sensor, Light Dependent Resistor, IR based sensor are displayed .The values are passed to the Seawater acrylic tube and then data is transmitted by the wireless technique to the receiver antenna. Also, the status (normal or abnormal) of the 4 interfaced sensors is indicated at the transmitter section .The RF transmitter transmits the encoded data to the receiver side.

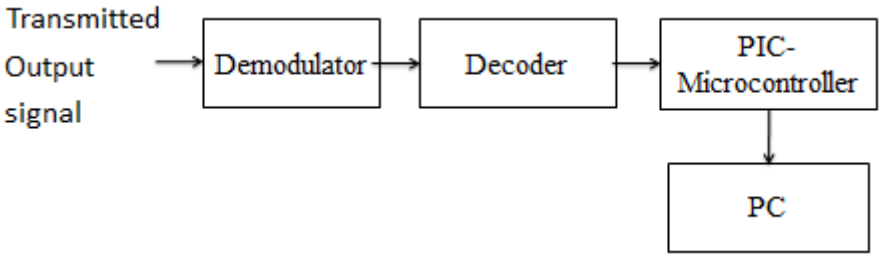

Fig. 3. Block diagram of receiver section

IV. PERFORMANCE ANALYSIS

The design of sea-water monopole antenna with its transmitter and receiver section is given below.

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Fig.4 (a) Receiver, monopole antenna and Transmitter

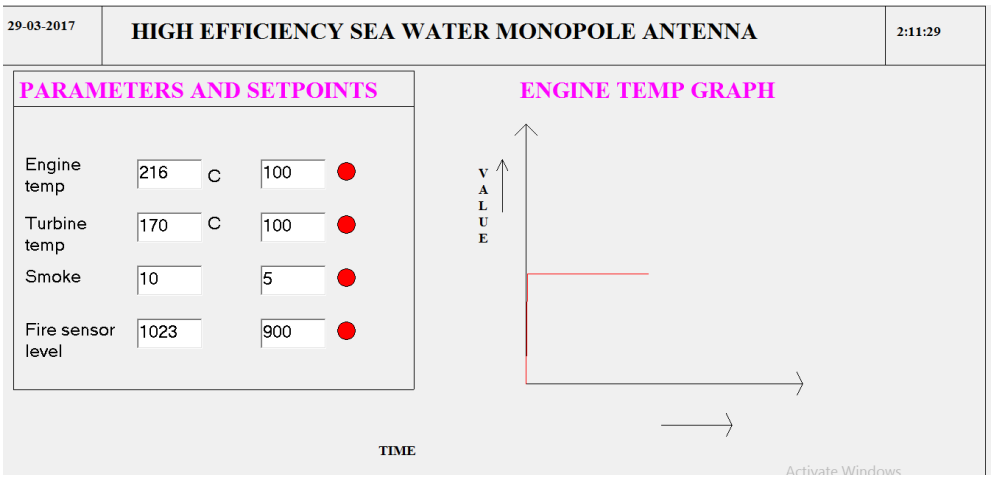

Fig.4(b) Sensed value displayed in the transmission section

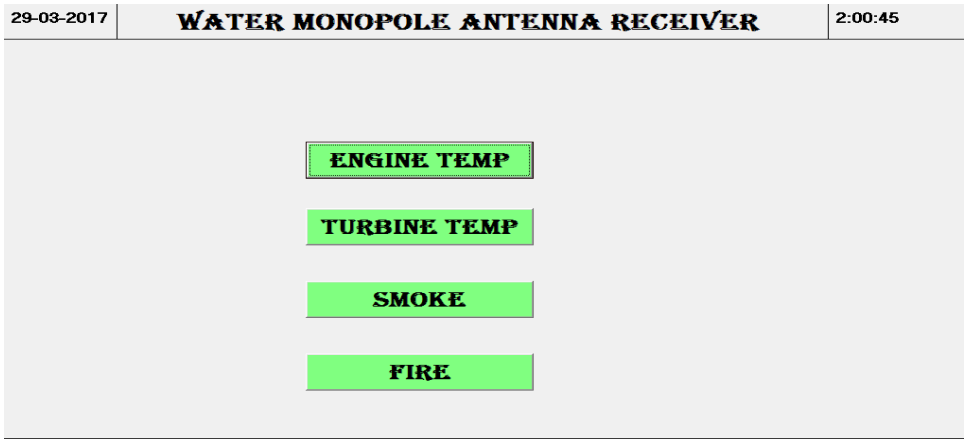

Fig.4(c) Showing normal status at the receiver

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V. CONCLUSION

Thus this project provides an efficient and reliable concept of sending data through salt water using tubular antenna. The concept is to transmit the submarine data. It can be implemented easily and comparatively the result is obtained in low cost. The system can send variables of submarine to the external world and Virtual instrumentation on the receiving side will be possible. In this project four sensors are used to sense various submarine parameters such as engine temperature, turbine temperature smoke, fire the values that are sensed are displayed at the transmitter side for monitoring purpose of the submarine. If needed, they are sent to another receiver who is supervising the parameters regularly. Instead of providing the set of sensed values to the receiver, we are providing only the status (normal or abnormal) and there is no further analysis required by the supervisor to distinguish the values within the acceptable range and out of range. We are using a simple software tool to represent the data.

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