

# **RF Based Maritime Application Using Monopole Antenna**

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**ABSTRACT:** A new transparent and reconfigurable Sea-water Monopole antenna operating at VHF band is proposed, which is well suited for maritime wireless communications. In comparison to the dynamic-type seawater monopole antenna in, our structure is relatively simple, mainly consists of a transparent plastic tube filled with sea-water and a top-loaded feeding probe. Furthermore, our proposed antenna has higher efficiency due to an efficient feeding structure and the thick sea-water cylinder used. The concept of our project is to save the fuel, time and life of submarine and water bound vehicles. By using Seawater Monopole Antenna is very efficient and it could be the reliable concept of sending data through salt water using Liquid antenna.

## **I. INTRODUCTION**

Now a day's no of methods are used for maritime communication. Our system is rf based maritime application using monopole antenna is to communicate with submerged submarines by using sea water monopole antenna at VHF band. Objective of our paper is decreased surveillance time, increase speed and reduce the fuel consumption and it is well suited for maritime wireless communication. For the purpose of communication we need periodic monitoring of various parameters. We are using data acquisition Systems to acquire data from the submarine and the continuous monitoring can be done in the control room.

In our 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.

A sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output. A sensor is a type of transducer; sensors may provide various types of output, the output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing. Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base, besides innumerable applications. With advances in micro machinery and easy-to-use micro controller platforms, Moreover, analog sensors such as potentiometers and force-sensing resistors are still widely used. Applications include manufacturing and machinery, airplanes and aerospace, cars, medicine, and robotics. It is also included in our day-to-day life. For example, if the mercury in a thermometer moves 1 cm when the temperature changes by 1 °C, the sensitivity is 1 cm/°C (it is basically the slope  $Dy/Dx$  assuming a linear characteristic). Some sensors can also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches.

Visual Basic is a third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model first released in 1991. Microsoft intends Visual basic to be relatively easy to learn and use. Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using data Access Objects, Remote data Objects, or ActiveX Data Objects, and creation of ActiveX controls and Objects. A programmer can create an application using the components provided by the Visual Basic program itself. Program written in Visual basic can also use the Windows

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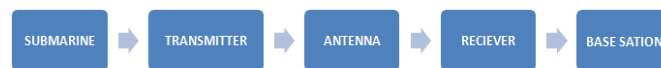
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API, but doing so requires external function declarations. Though the program has received critics for its perceived faults, version 3 of Visual Basic was a commercial success, and many companies offered third party controls greatly extending its functionality. The final release was version 6 in 1998. Microsoft's extended support ended in March 2008 and the designated successor was Visual Basic.NET (now known simply as Visual Basic). Though Visual Basic 6.0 is no longer officially available there remain a sizeable number of developers who still prefer Visual Basic 6.0 over .NET. A dialect of Visual Basic, Visual Basic for Applications (VBA), is used as a macro or scripting language within several Microsoft applications, including Microsoft Office.

To perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this paper an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors. The embedded controller selected for this project is PIC16F877A due to its various features.

## II. ARCHITECTURE

The architecture of our system consists of five basic blocks such as submarine, transmitter, antenna, receiver and base station. 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. 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 side.

## III. PIC EMBEDDED MICROCONTROLLER

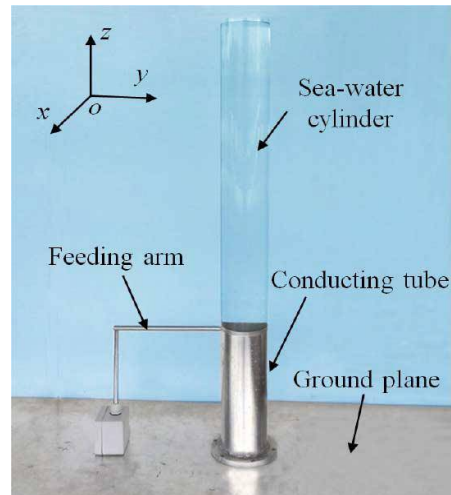
From the circuit it can be seen that the reference analog supply after being regulated by the 9v regulator enters the zener diode through the resistance R4 where it is again regulated to 5v since the zener diode used here has a cut off of 5v. Thus we have a double regulated completely filtered analog reference source. R6 is a potential divider used for setting the dynamic response range of the reference supply. This means that the reference 5v can be used as it is or it can be made into a fraction of the 5v for example 1v so that readings in this range can be read with more precision. This is because the ADC has 10 bit resolution which can be totally used for representing the 1v rather than 5v. The pins 2-5, 7-10, 35 and 36 are used as the 10 channels of the ADC. To these pins the analog inputs to be processed by the ADC are given. Y1 is the crystal oscillator used. It is of 10 MHz and gives a baud rate of 9600 bits/s. The capacitors C2 and C3 are used as decoupling capacitors to remove the high frequency noise signals. The capacitor C1 is in the off condition when power is switched off. When the power is switched on or reset then this capacitor gets charged through the resistor R2 and then through R1 this appears at the MCLR pin of the PIC. This is the memory clear pin and thus the memory is cleared and is ready for use as soon as power is switched on. S1 is the synchronous switch which is also used for the same operation and for PC and PIC synchronous operation.

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## IV. ANTENNA DESIGN



Liquid antenna was becoming an interesting topic. For a liquid antenna, the fluid that carries charged particles in the form of ions is used as the radiating medium. Due to the fluidity, the fluid can be pumped into a plastic tube and thereby “deployed” when the antenna is activated. When deactivated, the fluid can be pumped out or drained and the tube can also be removed. In our project, a new transparent and reconfigurable sea-water monopole antenna operating at VHF band is proposed, which is well suited for maritime wireless communications. In comparison to the dynamic-type sea-water monopole antenna, our structure is relatively simple, mainly consists of a transparent plastic tube filled with sea water and a top-loaded feeding probe. Furthermore, our proposed antenna has a higher efficiency due to an efficient feeding structure and the thick sea-water cylinder used.

### 9.1 Geometry of Seawater monopole Antenna.

The geometry of the sea-water monopole antenna mounted on a ground plane. 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 aluminium disk on the top before being inserted into the sea water. 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 be reconfigurable which means that its centre frequency and bandwidth can be adjusted by changing the height and radius of the sea-water cylinder. The dielectric constant of sea water is 81, and the conductivity is 4 S/m. However, it is worth mentioning that the electrical properties of sea water depend on its chemical composition which varies from place to place and from time to time. In addition, electrical properties of sea water vary with the temperature, pressure, and frequency. The electrical properties of sea water used here are characterized by using a coaxial line reflection method to obtain an accurate design. It is found that the dielectric constant of the available sea water varies between 77.6 and 79.8 over the frequency range of 30–300 MHz, while the conductivity varies between 3.9 and 4.2 S/m.

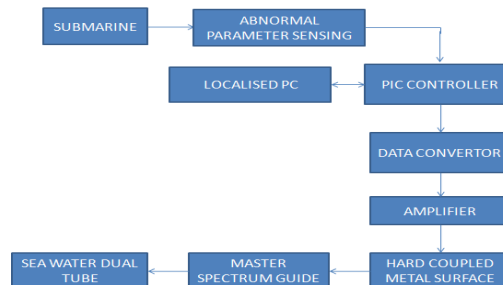
## V. TRANSMITTER

The 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.

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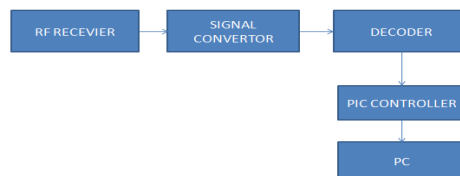
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The encoder in the RF transmitter module is connected to the data pins and transmission enable pin. The RS-232 which is in turn connected to the PC where the values of the thermocouple sensor, Thermistor sensor, Light Dependent Resistor, IR based sensor 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.

## VI. RECEIVER

The RF receiver module receives the encoded data and also presents it to the decoder. The data lines from the decoder are connected to the pins of the controller. The controller at the receiver side is programmed in a way that it indicates only the status (normal or abnormal) of the 4 interfaced sensors.



The RS-232 is connected to the pins C6 (TX), C7 (RX) of port C from the controller. The controller which is then connected to the PC. The PC indicates the status (normal or abnormal) of the 4 interfaced sensors.

## VII. DATA ACQUISITION SYSTEMS

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition System (abbreviated with the acronym DAS or DAQ) typically convert analog waveforms into digital values for processing. The components of data acquisition Systems include: Sensors, to convert physical parameters to electrical signals. Signal conditioning circuitry, to convert sensor signals into a form that can be converted to digital values. Analog-to-digital converters, to convert conditioned sensor signals to digital values. Data acquisition applications are controlled by the software programs developed using various general purpose programming language such as BASIC, C, FORTRAN, JAVA, Pascal, etc. Specialized Software tools are used for building large-scale data acquisition Systems includes EPICS. Graphical programming Environment ladder logic, Visual Basic, Visual C++ and Lab View.



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## SENSORS USED:

Thermistor sensor  
Thermocouple sensor  
Light dependent sensor(LDR)  
IR sensor

### THERMISTOR SENSOR

Thermistor is special type of resistor, whose resistance varies more significantly with temperature than in standard resistors. Generally, the resistance increases with the temperature for most of the metals but the thermistors respond negatively i.e. the resistance of the thermistors decrease with the increase in temperature.



This is the main principle behind thermistor. As the resistance of thermistors depends on the temperature, they can be connected in the electrical circuit to measure the temperature of the body.

### THERMOCOUPLE SENSOR

Two strips of dissimilar metals joined to form junction called Thermocouple. If the junction is heated and a milli-voltmeter is connected across the free ends away from the junction, there will be found a voltage present.



This voltage is caused by the different work function of the metals forming the junction and is dependent upon both the temperature and the types of metals used.

### LIGHT DEPENDENT SENSOR(LDR)

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices.



They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance.

### IR SENSOR

IR detector is having reverse characteristics of the IR emitter. That is we cannot consume more current from it on account of positive sensitivity. For the above grounds we have used 100k from the supply voltage. So the sink current will be as per the ohm's law. So  $5/100k$  will be less than a micro ampere which may improve the detecting characteristics.

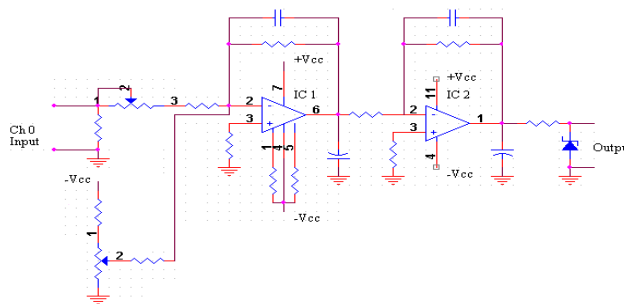
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## SIGNAL CONDITIONING CIRCUIT

In electronics, signal conditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. Most common use is in analog-to-digital converters. In control engineering applications, it is common to have a sensing stage (which consists of a sensor), a signal conditioning stage (where usually amplification of the signal is done) and a processing stage (normally carried out by an ADC and a micro-controller).



Operational amplifiers (op-amps) are commonly employed to carry out the amplification of the signal in the signal conditioning stage. In our system, the sensor inputs are given to signal conditioning circuit. For our circuit input will be 0v to 1000mv and must be amplified to 5volts and creating offset and null adjustments which may occur during amplification. Offset and null is the one which is available in all OPAMPS.

## RF TRANSMITTER

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. Finally, radio circuits are usually subject to limits on radiated emissions, and require Conformance testing and certification by a standardization organization such as ETSI or the U.S. Federal Communications Commission (FCC). For these reasons, design engineers will often design a circuit for an application which requires radiocommunication and then "drop in" a pre-made radio module rather than attempt a discrete design, saving time and money on development. RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infra red communication designs as they have the advantage of not requiring line-of-sight operation. Several carrier frequencies are commonly used in commercially-available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz. These frequencies are used because of national and international regulations governing the use of radio for communication. Short Range Devices may also use frequencies available for unlicensed such as 315 MHz and 868 MHz.

## RF RECEIVER

An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: super heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Super heterodyne receivers have a performance advantage over super-regenerative; they offer increased

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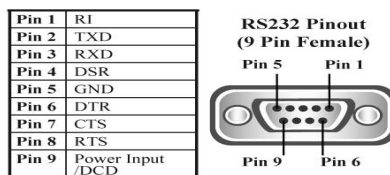
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accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in turn leads to a comparatively more expensive product.

## RS232:

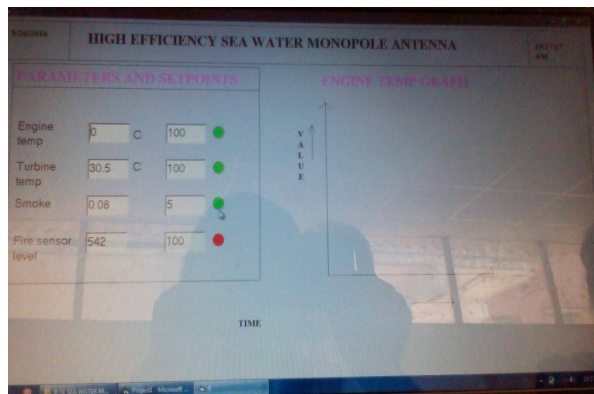
Computers transfer data in two ways: parallel and serial. In parallel data transfers, often 8 or more lines (wire conductors) are used to transfer data to a device that is only a few feet away. Examples of parallel transfers are printers and hard disks; each uses cables with many wire strips.

### BL-830 RS232 Pinout

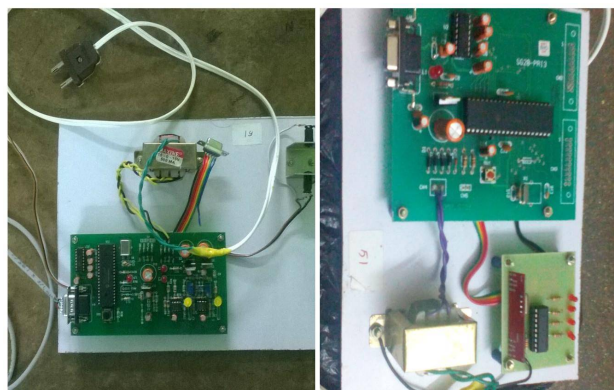


Although in such cases a lot of data can be transferred in a short amount of time by using many wires in parallel, the distance cannot be great. To transfer to a device located many meters away, the serial method is used. In serial communication, the data is sent one bit at a time, in contrast to parallel communication, in which the data is sent a byte or more at a time.

## VALUES DISPLAYED IN THE TRANSMITTER SECTION



## SENSOR AND RECEIVER SECTION

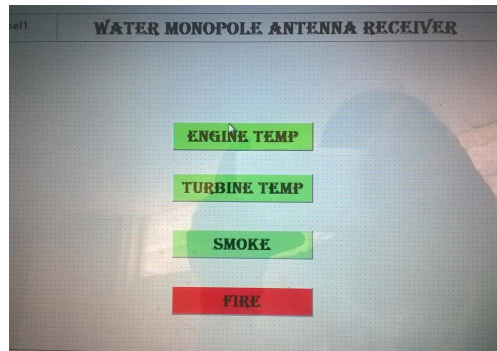


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## ABNORMAL STATUS AT THE RECEIVER SECTION



## VIII. CONCLUSION

The purpose of our system provides an effective an efficient and reliable concept of sending data through salt water using liquid antenna. Our antenna provides an 80-95% of efficiency. It can be easily implemented and comparatively the result is obtained in low cost. This concept saves fuel, time and life of submarine and water bound vehicles. This concept can be enhanced for many other applications in the future to the internet of things (IOT). Now we use RF for transmitting data where as in future we can transmit data using light fidelity(Li-fi).

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