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SMART DETECTION SYSTEM FOR DIVERS USING UNDERWATER ACOUSTIC COMMUNICATION

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Abstract: In underwater research environment the health issues faced by diver is a major challenge. During deep sea diving, several parameters of diver have to be monitored continuously for successful researches like study of plant and animal behavior. The proposed system will sense and analyze various health problems and status of the diver by using various sensors. Ultrasonic sensor Received Signal Strength Identification (RSSI) is used to find the exact location of the diver. If diver becomes unconscious then it causes severe issue. To overcome this problem, pressure sensor is used to monitor the pressure and Micro Electro Mechanical Systems (MEMS) sensor is used to monitor the action of the diver. In case of emergency, air bag is opened safely for the diver. The continuous monitoring of the session was done with the control unit to supervise the status of the diver via wireless sensor network to provide exact location ensuring the safety of the diver.

Keywords: Health monitoring system, Ultrasonic sensor, MEMS sensor, Heart beat sensor

I. INTRODUCTION

Wireless underwater acoustic communication is an enabling technology for the development of ocean surveillance systems. There are different technologies existing in the underwater communication field such as electromagnetic transmission, optical transmission and sound wave transmission. For short range, high data rate transmission, acoustic communication is most suitable since the sound waves are less attenuated by salt water. Nowadays application of acoustic communication in wireless undersea networks is very prominent.

Underwater environment can be considered as an extreme environment where imposes severe problems to human survival. Environmental circumstances make equipment functioning and communication complicated, and evacuation of patient becomes difficult. In the proposed system, we are concentrating to overcome the problem which are facing by the divers in deep sea. Up to 30 m depth the gas acts as normal after that it becomes toxic due to greater depths. Hence to monitor the depth we used ultrasonic sensor with RSSI to find the exact location of the diver. Due to high pressure, the diver may affect due to the nitrogen narcosis. Except helium and neon all other gas have anaesthetic effect at high pressure, therefore helium contained gas mixture is usually carried by the diver while diving. Breathing gas mixture should enter the diver's lung when a pressure equivalent to the ambient pressure.

Diver can self-equipped and control the partial pressure of breathing gas. But if diver become unconsciousness then it causes severe issue, to overcome this we used pressure sensor to monitor the pressure. Obstacle detector is used to detect the obstacle and find the exact depth of the diver. Finally the MEMS were used to monitor the action of the diver. In case of emergency air bag is opened safely for diver. In the model motor is used instead of airbag. RSSI is used internally in wireless networking card to determine when the amount of radio energy in the channel is below a certain threshold at which point the network card is clear to send (CTS). Once the card is clear to send, a packet of information can be sent from transmitter to receiver. In receiver another RSSI is used to receive the information.

II. ACOUSTIC COMMUNICATION

Underwater acoustic communication is a technique of sending and receiving messages below water. Underwater communication is difficult due to factors such as multi-path propagation, time variations of the channel, small available bandwidth and strong attenuation, especially over long ranges. Compared to terrestrial communication, underwater communication has low data rates because it uses acoustic waves instead of electromagnetic waves. At the beginning, some ships communicated by underwater bells, the system being competitive with the primitive Maritime radio navigation service of the time. The later Fessenden oscillator allowed communication with submarines. In general the modulation methods

developed for radio communications can be adapted for underwater acoustic communications (UAC). others. Some of the modulation methods used for UAC is as follows:

A. Frequency Shift Keying as applied to UAC

FSK is the earliest form of modulation used for more advanced forms of UAC by acoustic modems. The earliest form of UAC prior to FSK has been by percussion of different objects underwater and this method has been used to measure the speed of sound in water. The biggest challenge FSK faces in the UAC is multi-path reflections. With multi- path (particularly in UAC) several strong reflections can be present at the receiving hydrophone and the threshold detectors become confused, thus severely limiting the use of this type of UAC to vertical channels. Adaptive equalization methods have been tried with limited success. Adaptive equalization tries to model the highly reflective UAC channel and subtract the effects from the received signal. The success has been limited due to the rapidly varying conditions and the difficulty to adapt in time.

B. Phase Shift Keying

Phase-shift keying (PSK) is a digital modulation scheme that conveys data by changing (modulating) the phase of a reference signal (the carrier wave).The signalisimpressed into the magnetic field x, y area by varying the sine and cosine inputs at a precise time. It is widely used for wireless LANs, RFID and Bluetooth communication.

C. Orthogonal Frequency-Division Multiplexing

Orthogonal Frequency-Division Multiplexing (OFDM) is a digital multi-carrier modulation scheme. OFDM conveys data on several parallel data channel by incorporating closely spaced orthogonal sub-carrier signals. OFDM is a favorable communication scheme in underwater acoustic communications thanks to its resilience against frequency selective channels with long delay spreads. Use of vector sensor receivers

III. PROPOSED WORK

In this project we continuously monitor the health condition of the divers with the use of the sensors. The system sense and analyze various health problems and status of the driver. The monitoring session was done with the control unit that is., the status of the driver is sent to the control unit via wireless sensor network. In the proposed system, we are concentrating to overcome the problem which are facing by the divers in deep sea. Up to 30 m depth the gas acts as normal after that it becomes toxic due to greater depths. Hence to monitor the depth we used ultrasonic sensor with RSSI to find the exact location of the driver. Due to high pressure, the diver may effect of the nitrogen narcosis. Except helium and neon all other gas has anesthetic effect at high pressure, therefore helium contained gas mixture is usually carried by the diver while diving. Breathing gas mixture should enter the diver's lung when a pressure equivalent to the ambient pressure. Diver can self-equipped and control the partial pressure of breathing gas. But if diver become unconsciousness then it causes severe issue, to overcome this we used pressure sensor and temperature sensor and also to monitor the pulse, heart beat sensor is used. Finally the MEMS were used to monitor the action of the diver. In case of emergency air bag is opened safely for diver.

A.ULTRASONIC SENSOR

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Figure 1Ultrasonic sensor

Ultrasonic sensor module comprises of one transmitter and one receiver. The transmitter can deliver 40 KHz ultrasonic sound while the maximum receiver is designed to accept only 40 KHz sound waves. The receiver ultrasonic sensor that is kept next to the transmitter shall thus be able to receive reflected 40 KHz, once the module faces any obstacle in front. Thus whenever any obstacles come ahead of the ultrasonic module it calculates the time taken from sending the signals to receiving them since time and distance are related for sound waves passing through air medium at 343.2m/sec

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B. MEMS Sensor

Micro-Electro-Mechanical Systems, or MEMS, is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of micro fabrication.

C. MEMS Accelerometer

An accelerometer is an electromechanical device that is used to measure acceleration and the force producing it. They can be divided according to the force (static or dynamic) that is to be measured. Even today, one of the most commonly used one is the piezoelectric accelerometer. But, since they are bulky and cannot be used for all operations, a smaller and highly functional device like the MEMS accelerometer was developed. Due to its small size and robust sensing feature, they are further developed to obtain multi-axis sensing.

D. Pressure Sensor

A force-sensitive resistor (alternatively called a force-sensing resistor or simply an FSR) has a variable resistance as a function of applied pressure. In this sense, the term "force- sensitive" is misleading – a more appropriate one would be "pressure-sensitive", since the sensor's output is dependent on the area on the sensor's surface to which force is applied.

When external force is applied to the sensor, the resistive element is deformed against the substrate. Air from the spacer opening is pushed through the air vent in the tail, and the conductive material on the substrate comes into contact with parts of the active area.

E.RSSI

RSSI is the relative received signal strength in a wireless environment, in arbitrary units. RSSI is an indication of the power level being received by the receive radio after the antenna and possible cable loss. Therefore, the higher the RSSI number, the stronger the signal. Thus, when an RSSI value is represented in a negative form (e.g. −100), the closer the value is to 0, the stronger the received signal has been.

F. TRANSMITTER MODULE WORKING

Ultrasonic, Pressure and MEMS sensor is connected to the microcontroller through ADC. If any sensor value goes beyond the threshold value, the relay gets ON and the motor will run. Then the information about the status of the diver is monitored in the receiver side with the help of RSSI. RSSI is used to find the exact location of the diver in positive and negative x-y direction. The diver can be easily rescued.

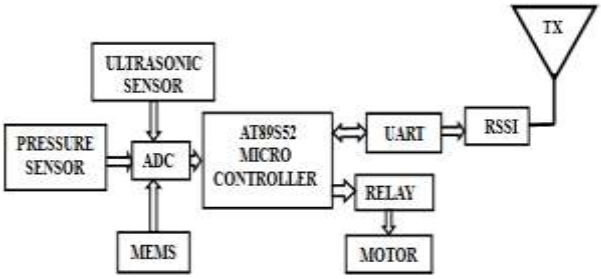

Figure 2 Block Diagram of Proposed System Transmitter

G. Receiver Module

The receiver module receives the transmitted signal and converts the signal into required form using UART. The status of the diver such as heart beat rate, blood pressure are viewed continuously and in case of emergency, air bag will be opened to save the life of diver.

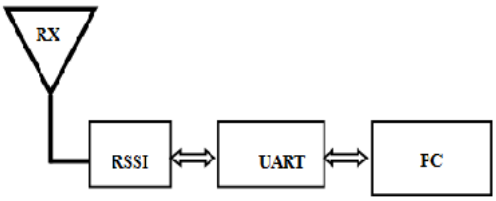

Figure 3 Block Diagram Of Proposed System Receiver

IV. CONCLUSION

The major concerns in the underwater research environment was health issues faced by diver during deep sea diving. It will sense and analyze various health problems and status of the diver by using various sensors. The use of communications systems might have allowed them to be located faster, and might even have prevented the accident. Thus leads to the necessity of the efficient health monitoring system with, Continuous monitoring of diver and Provides exact location and ensure the safety of diver.

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