**Background:**

Driven by a keen interest in adventure experiences and powerful global tourism trends, scuba diving is becoming a more and more popular recreational sport. According to PADI (Professional Association of Diving Instructors), one million new divers worldwide are trained annually [1]. The safety issues related to scuba diving have been a big concern ever since the dawn of diving history. An average of 80 fatalities and 2,000 injuries are reported annually, in which 25% are due to decompression sickness and nitrogen narcosis. Due to the high pressure of sea water, the nitrogen concentration in the blood vessel rises when a scuba diver is under water. When the concentration reaches a certain level, nitrogen narcosis happens. It causes a diver’s judgement to be impaired. Poor concentration ensues if the diver continues to stay at the same depth. Furthermore, the dissolved nitrogen will form bubbles on depressurization when a diver surfaces too fast. This induces numbness and vertigo. Both nitrogen narcosis and decompression sickness are extremely dangerous illnesses for divers because they are not able to control themselves when affected by the symptoms related. In the worst scenario, a diver won’t be able to come up and die from drowning.

**Problem:**

The traditional diving regulator provides the divers with a table indicating the maximum length of time a diver can stay under water at a certain depth without experiencing nitrogen narcosis and decompression sickness during surfacing. However, such no-stop time is not accurate enough as it varies among people because of the differences in the conditions of their bodies. As a result, nitrogen narcosis badly affects hundreds of people and around 100 persons die from nitrogen narcosis each year.

**Solution:**

The solution we provide is an intelligent nitrogen level sensor integrated with the breathing regulator.

The intelligent sensor contains two major components, one is the flow capacity and concentration sensor integrated with Bluetooth adaptor, the other is a preprogramed chip. The device will be integrated inside the breathing regulator to record the absorbed nitrogen amount through each inhale and exhale.

Under initialization, the device will ask the user his/her body weight, then estimates the total volume of blood in the user’s body. When the user is underwater, the device will detect the flow speed of inhaling and exhaling along with the nitrogen concentration respectively, the computer calculates the exact amount of nitrogen of each whole breath, then derives the difference of the amount of nitrogen and add it up to the accumulated nitrogen. The real-time information of blood nitrogen concentration will be sent to the dive computer integrated with preprogramed chip for calculating user’s body tolerance of nitrogen.

The dive computer’s lighting indicator will range from green, yellow to red depending on the concentration of blood nitrogen.

Once the accumulated nitrogen has reached the level that will soon go beyond the tolerance of the diver but still enables the diver enough time for safe surfacing, the dive computer will alarm the diver by creating loud sound and beaming red lights to warn the diver. Then the diver will follow the instruction of the device to complete his/her safe stopping and finally, safe surfacing.

**Implementation:**

To produce and develop this device, five steps will be taken.

1. Cooperate with a computer-engineering research team to clear out other technical issues related to the sensor and produce a prototype.
2. Conduct a survey of mainstream diving regulators and modify the prototype to make it compatible with them.
3. Test the performance of the device underwater to improve on it.
4. Collaborate with a company for mass production.
5. Promote the selling and make more improvements with the feedback of customers.

**Benefits:**

Our solution will benefit divers and encourage people to experience scuba diving by enhancing the safety method and reducing fatalities. With more accurate and real-time data about body nitrogen level, divers will be equipped with the capability of making more appropriate decisions when surfacing or facing emergency. Divers will acquire more accurate no-stop time to have the nitrogen in their bodies released and mitigate the effects of decompression sickness and nitrogen narcosis. Thus, more people can enjoy themselves in recreational scuba diving with ensured safety. Beginners will be able to handle decompression sickness better, and experienced divers can plan and enjoy deep diving without worrying about nitrogen narcosis.

**Costs:**

Nitrogen flow capacity and concentration sensor $200

Pre-programmed chip $10

Electrical wires for connection $3

Bluetooth transmitter $5

Bluetooth receiver $5

Total $223

**Conclusion:**

The current solution to avoiding decompression sickness and nitrogen narcosis is not appropriate in that it fails to take into consideration the physical condition of each scuba-diving individual. The proposed intelligent nitrogen sensor aims to give the divers more accurate and timely alert on when to surface to remain free from. This will significantly reduce the number of people suffering from decompression sickness and nitrogen narcosis and make scuba diving a safer kind of sport as a whole.

Words:799

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