Smart Scuba Suit

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***Abstract*-Smart scuba suit is a diving apparatus which helps diving much more comfortable and safe than conventional system. Electronic control unit with embedded environmental sensor monitor the quality of air and ensure the diver has very comfortable breathing, this system will also monitor the breathing pattern of driver to check if there are any implausible situation.**

Key words-buoyancy

I. INTRODUCTION

Scuba diving is a form of underwater diving where the diver uses a self-contained underwater breathing apparatus (scuba) which is completely independent of surface supply, to breathe underwater. Scuba divers carry their own source of breathing gas, usually compressed air, allowing them greater independence and freedom of movement than surface-supplied divers, and longer underwater endurance than breathhold divers. Open circuit scuba systems discharge the breathing gas into the environment as it is exhaled, and consist of one or more diving cylinders containing breathing gas at high pressure which is supplied to the diver through a regulator. They may include additional cylinders for decompression gas or emergency breathing gas. Closed-circuit or semi-closed circuit rebreather scuba systems allow recycling of exhaled gases. The volume of gas used is reduced compared to that of open circuit; therefore, a smaller cylinder or cylinders, may be used for an equivalent dive duration. Rebreathers extend the time spent underwater compared to open circuit for the same gas consumption.

The defining equipment used by a scuba diver is the eponymous scuba, the self-contained underwater breathing apparatus which allows the diver to breathe while diving, and is transported by the diver. As one descends, in addition to the normal atmospheric pressure at the surface, the water exerts increasing hydrostatic pressure of approximately 1 bar for every 10 m of depth. The pressure of the inhaled breath must balance the surrounding or ambient pressure to allow inflation of the lungs. It becomes virtually impossible to breathe air at normal atmospheric pressure through a tube below three feet under the water.

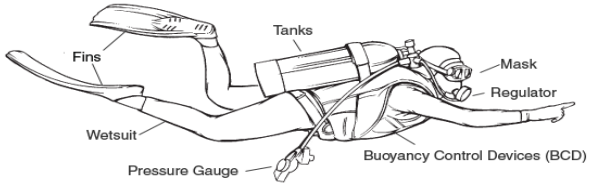

Fig .1 Scuba diver

II. PROPOSED SYSTEM

Smart scuba suit is an integrated diving method to overcome the drawbacks of current system.The main features of this system are ease of breathing,so one can dive comfortably.It can log the environmental data like depth of water, pressure and temperature.Also provides the groundstation communication.

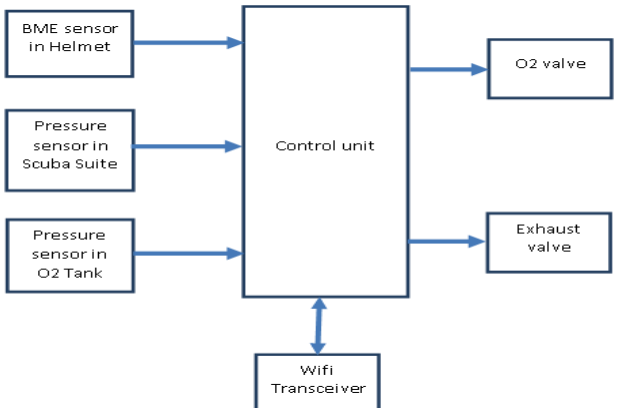

Fig .2 Block Diagram

Fig. 3 implemented model

III. FEATURES

A. Ease of breathing

Usually the scuba diver inhale and exhale through a mouthpiece. Which should be held throughout the diving time. Smart scuba suit contains an air tight helmet equipped with environmental sensors and embedded control unit,

which allow the diver to breathe through nose. The air cavity in helmet will be initially supplied with fresh air, then the diver can breathe directly from the helmet and after some breath cycle, the air inside the helmet need to be fleshed out with fresh air, this is controlled by opening exhaust valve and open oxygen tank valve. Air quality of air inside the helmet will be continuously monitored by environmental sensor and oxygen supply valve will be controlled by associated embedded control unit.

B. Breathing Pattern monitor

The integrated pressure sensor in the helmet record the breath pattern by means of pressure variation of inside air when the diver breathe in / out. Inside pressure will increase when the diver breath out and it will decrease when he breath in. so by measuring the time gap between two maximum pressure / minimum pressure, we can find the frequency of the breathing. This measured and calculated frequency will be compared against lower and upper threshold continuously after every cycle, to check for any panic situation. In case of any abnormalities in the breathing cycle, the system will inform the ground station by means of integrated Wi-Fi transceiver

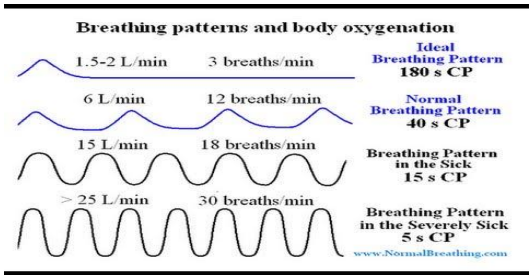

Fig. 4 Breathing patterns and body oxygenation

C. Environmental data logging

Pressure, depth, temperature are recorded in each moment.So we can use this data for further references.Pressure sensor in suit can continuously check the depth of water and can warn the diver if the depth more than allowed range or, depth is not safe with current available air in the tank.Depth is calculated from the water pressure.For every 33 feet (10.06 meters) you go down,pressure increases by 14.5 psi.

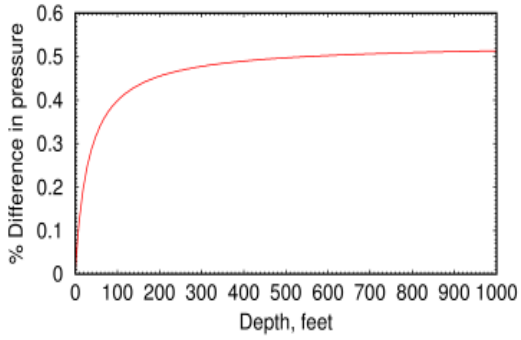

Fig. 5 Pressure vs depth graph

D. Electronic buoyancy control device(BCD)

Buoyancy control is a matter of balancing the downward force of divers ballast weights against the upward force.When the two cancel out,diver is neutral and can hover in the water .This can be controlled by letting some air enter into the BCD air chamber.By adjusting the air one can adjust neutral height. Diver can activate tristate switch to select any of BCDmodes. The BCD modes are,

1. Diver can ascend downward by removing the air collected in BCD air chamber.
2. Diver can stay neutral by preciously inflating the BCD chamber.
3. Swim upward by inflating more air to BCD chamber.

Additional safety of BCD:

when the integrated sensor detect an implausible situation in breathing pattern of diver,irrespective of the selected BCD mode by diver,the BCD valve open completely and inflate the BCD chamber very quickly resulting in the rise of the diver to the water surface.so that he can be rescued by the ground staff.

IV. CONCLUSION

Smart scuba suit will make scuba diving much comfortable and safe with its integrated sensors and smart control unit. Timely control of valves and real time monitoring of air quality make the system much reliable and safe. Current system lacks the monitoring and the safety of the diver. This system can continuously monitor the breath pattern of diver by digital signal processing of digital sensor data, such as pressure variation due to breathing. With help of integrated Wi-Fi module, one can track the status of diver from ground station. It also has a data logger like, depth, pressure, and water temperature which can be used for different studies.

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