AUTONOMOUS METEOROLOGICAL BUOY

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Abstract—The project has the aim of developing an autonomous meteorological buoy for an operation in the Mediterranean Sea. It is supposed to acquire weather and sea related data and transmit it to a base station on land for further processing and analyzing. Due to the autonomous work special requirements on the equipment are necessary. The problems with the energy supply, the communication to the base station and the handling of the measurements have to be solved. Also a robust, floating and reliable mechanical design has to be set up to provide enough space and correct operation of the equipment. Finally the operation has to be ensured through long term testing and further improvements.

Keywords— Autonomous; Buoy; E8 debugger; High performance Embedded Workshop; IEEE 1451.4; Iridium Connection; LabView Interface; Meteorological; Micro Controller; Photovoltaic Power Supply; Smart Sensor Network

I. INTRODUCTION

This document describes the process and the necessary steps for developing an Autonomous Meteorological Buoy for the coastal operation in the area of "Costa Brava". The buoy will store different meteorological and sea related data and send it to a base station. To provide this function a smart sensor network is built based on the IEEE 1451.4 standard and RENESES 16 Bit Micro Controller. For the communication the Short Burst Data Service of IRIDIUM is used. This is an easy and reliable way for transmitting data all over the world. The power supply is realized through an autonomous photovoltaic system with storage unit and converters to achieve the required voltage levels. The user interface is designed to work on a personal computer with LabView. The data will be prepared and shown.

II. POWER SUPPLY

The buoy is powered by a photovoltaic system with a storage device to provide energy even during periods without sunlight. A charge controller handles the power provided from the panels and charges a maintenance-free
Lead-Acid battery, which can supply power to the system for approximately five days without sunlight. Further high efficient DC-DC switching converters maintain correct and stable voltage levels for the components. To improve efficiency, components which are not in use can be switched off by the Micro controller or controlling circuits.

III. SMART SENSOR NETWORK

Plug and Play sensors, which meet IEEE 1451.4 standard, are used to process the marine meteorological parameters such as wind, air temperature, air pressure, water temperature, pressure and salinity. The number of meteorological parameters, sensor types, and rate of measurements can be adjusted, depending on the customer requirements.

IV. COMMUNICATION

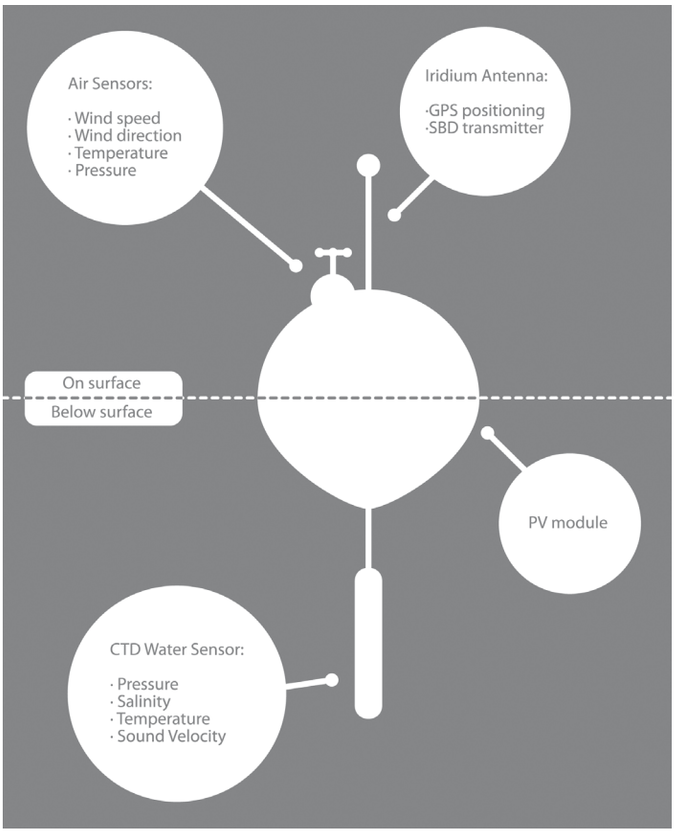
An iridium communication system is used to transmit the data collected by the sensors to the shore. This system guarantees the safe transmission of Short Burst Data (SBD) proto.

V. USER INTERFACE

It is based on LabView which provides data monitoring. Data is extracted and sent by email through a communication system. Parameters such as wind speed and direction, temperature, etc. will be displayed. Further data can be saved and monitored in diagrams to carry out long term research of parameters.

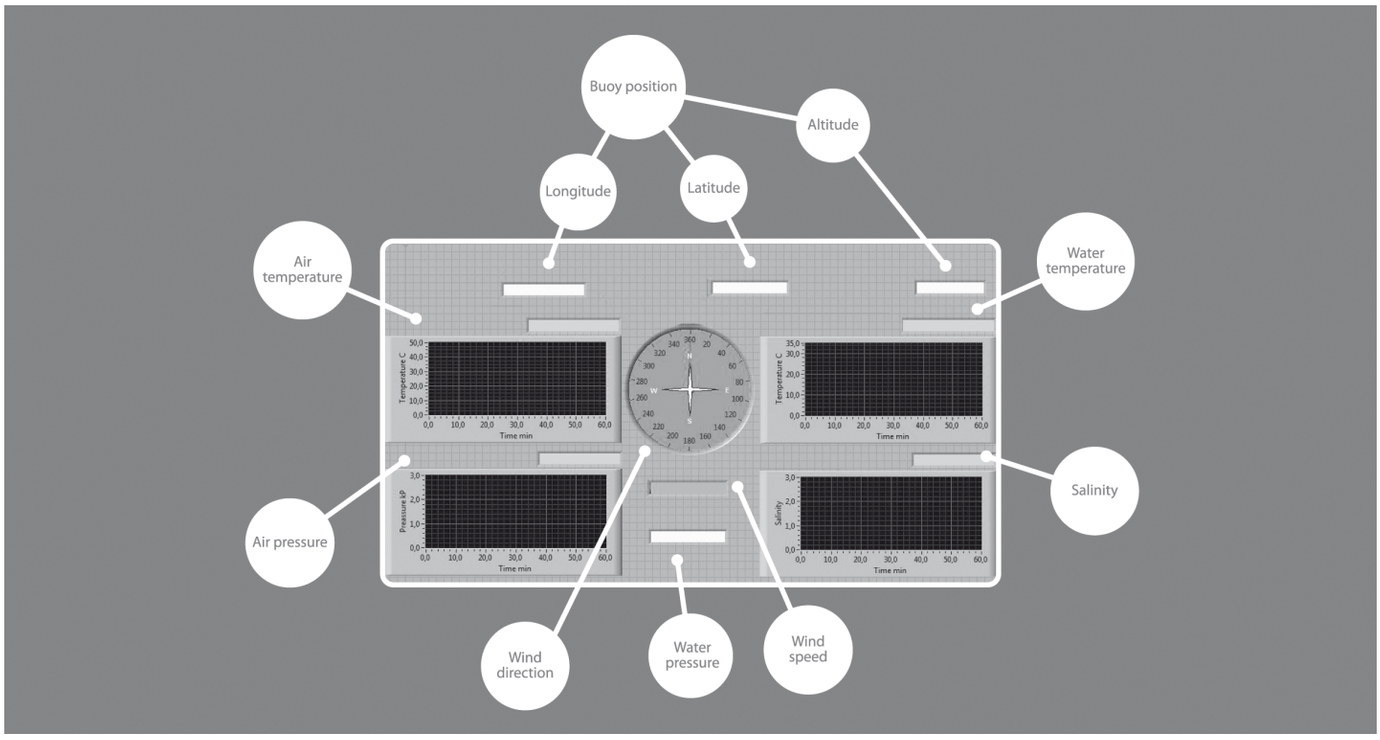
VI. MECHANICAL DESIGN

A buoy was designed to hold all the equipment and sensors. Important considerations for its construction were the placing and dimensions of the solar panels in order to provide sufficient space for the electrical equipment and ensuring floatability and long term durability. A technical drawing with the most important parts was carried out, a suitable material for the body was chosen and a calculation for improving floatability was carried out.



VII. CONCLUSION

The base for an AMB was constructed. According to the power supply detailed research for suitable solutions was carried out. Supplying an autonomous buoy with independent power supply is not a common task and needs a lot of additional knowledge. Special, maintenance free, reliable and long term components had to be found or to be developed. The solution with the fixed converters and the parts which can be turned off keeps the design easy and saves energy. When the needs of the sensors and auxiliary circuits finally will be defined, it can be adapted easily with other components.
Transmitting data via IRIDIUM connection is a good solution for this application. The data volume collected by the buoy does not demand high transmission velocity and therefore the SBD satisfies the needs. With this type of communication setup additional data as the position and the precise time can be obtained with one device. The modem can be controlled with the µC through RS232 connection. Further developing includes addition of a memory to buffer data. Then the iridium modem can be put into sleep mode and this would help to save energy.
The plug and play sensor network makes it easy to add new sensors. The board for the bus connection can be expanded because it uses RJ45 connectors which provides power supply for every sensor and mixed mode interface. The number of sensors is just limited by the analogue inputs of the µC and the size of the SBD message. With the CAD 5 connectors a widely used connection was created. To improve the operation of the sensor network all the resources of the Subsea sensor should be used as for example getting the sound velocity and real time and date.
Data monitoring with LabView was enabled. The relevant data can be extracted



from the Email which is prepared and displayed. One of the biggest advantages of LabView is that existing setups can be enlarged by other functions without requiring changes on the rest. When all types and amounts of measurements are fixed the interface should be adapted.

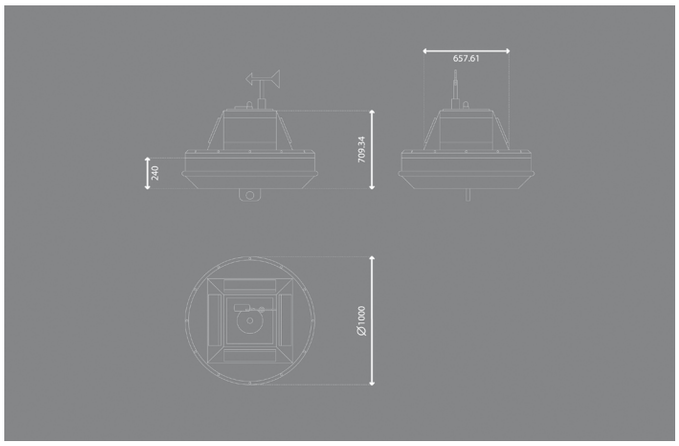
An evaluation of different buoy designs with similar purpose as AMB was done. After a first draft the design was adapted to the size and requirements of the equipment. Floating calculations were carried out and different kinds of mooring possibilities were figured out. Solutions for the buoy materials, colors and placement of the components are shown. Based on the acquired data and the drafts, the real buoy can be designed when it is clear which equipment is going to be used. As already mentioned in the project proposal there is no physical working buoy. With the realized work and the documents found, big steps in setting up an AMB were made.

VIII. APPENDIX

Appendixes, if needed, appear before the acknowledgment.

IX. ACKNOWLEDGMENT

The project group of AMB wants to thank the staff members of the UPC Vilanova i la Geltru. Special thanks to our supervisors Mr. Del Rio and Mr. Andrada for their support, patience and invested time. Furthermore we want to thank the members of the International department and Mr.Segalàs who made all this possible.



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