Supervisor Dredging Equipment:
Remote and Real time control of the dredging processes

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Abstract *- We present a system for monitoring and supervise ecological dredging. Currently, dredging processes are a necessity for a proper marine and river resources exploitation: construction and maintenance of port infrastructure, improving navigability... However, current dredging techniques can cause serious problems to the environment. This system emerges as a need to improve efficiency and control of dredging activities. To do this, hardware and software elements will be deployed to monitor, record and display in real time each of the relevant actions in a dredge operation.*

Keywords *- Dredge, Supervisor Equipment, Bathimetry, Web Service.*

I. INTRODUCTION

Dredging needs and environmental effects

Ports and navigation channels are keys for the economy of large regions, covering a variety of activities: maritime traffic and supply industries, fisheries and food distribution, sports, tourism and all sort of related services. These are vivid economic areas whose progress and strength are tightly connected to the richness of the coastal belt.

Dredging is a critical maintenance activity of navigation channels and specifically of ports located at the bottom of an estuary, to preserve their activities: the bay of San Francisco (USA) would be closed to traffic within one year otherwise. Without an efficient dredging, the continuous changes would affect and reduce ship traffic to avoid danger situations in the local navigation (the larger naval, commercial, industrial and recreational ships need more than 10 meters depth waters). Keeping operative the channels is a paramount of the economic activity.

Water turbidity causes the most important environmental impact due to dredging activities. Mud is loaded with contaminant agents: mercury, cadmium, petroleum-derived PAHs, dioxins and PCBs. When dredged materials are brought to the ship or put back, the water flowing out disperses the contaminants, being introduced in the trophic chains.

Control of the environmental effects of a dredging process

The Supervisor Dredging Equipment we developed acts like a ‘black box’ catching all the information it needs to give a complete vision of the dredge interaction with the environment. All this information is put to the service of the dredger and also to the contractor of the dredging project and all in real time and in any place via internet.

In the last years we have developed industrial level prototypes (ECODRAGA). This result position our technology as one of the most promising worldwide.

II. SYSTEM DESCRIPTION

Monitoring and data acquisition

The Supervisor Dredging Equipment or SDE, has a Data Adquisition Unit or DACU as the system central unit. This unit collects a lot of information from different systems and sensors to perform the dredge monitoring.

The DACU has an electronic module based on Arduino [1] board which is responsible for acquiring data from different sensors:

GPS device.

IMU sensor (Inertial Measurement Unit) ready to provide direction and orientation data.

Mareograph or tide gauge for measuring the sea level.

Pressure sensor for measuring the dredge's waterline.

Electrical signals provided by the dredge operation systems.

In addition, the system has two additional elements to complete the monitoring with essential information:

Multibeam bathymetric probe for analysis of the seabed.

Pictures and video of the dredge work with an underwater HD Camera and another one on deck.

All this raw data is served as data packets via an ethernet communications module integrated into the DACU. Then, data will be received and processed by a computer unit.

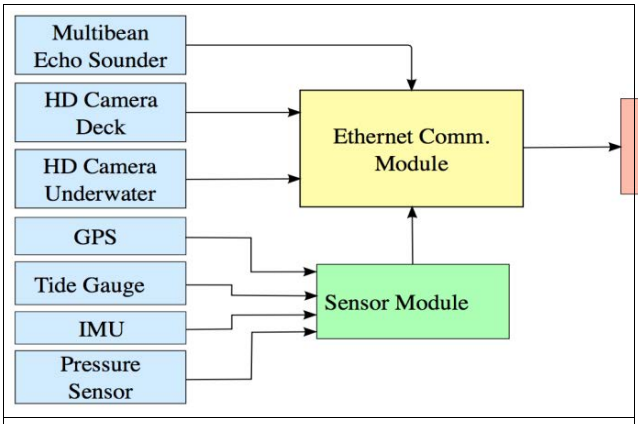

Fig. 1: Connection diagram with different systems and sensors needed for monitoring

Processing and storage software

To store and process the data, the SDE has a mini computer unit with embedded Linux, the Odroid-U3 [2]. This computer runs the supervisor dredging EcoDredge software, which is responsible for centralizing, record and process the information collected. It is composed of six different software modules:

1.DACU data receptor module.

2.Multibean probe data adquisition and calculation module.

3.Video and image georeferencing module.

4.Multibean probe and sensor data synchronization module.

5.Bathymetric autonomous processing module.

6.Recording and storing data module in a MongoDB database.

Web service, visualization and supervision

The SDE offers a web service to access to the stored information in the database or even configure the system. The web service runs in the same computer beside EcoDredge supervisor software and implements a RESTFul [3] HTTP-based protocol. Through an internet HTTP requests API, the service can offer to any client the generated and stored information ready for supervision.

The own system offers a web page as a web service client. From this web page, every user can display and monitor all relevant information as georeferenced images or bathimetries. In addition, this web page implements an user manager which provides some advanced system configuration tools to authorized users.

III. PURPOSE AND BENEFITS

This system offers a quality control tool on dredging activities and pollution generated. At any time, a supervisor can access to key moments and check by visualization and interpretation of the recorded and processed data the status of the work. This offers the advantage of keeping under control the level of pollution generated by the dredging.

It also offers the dredger the possibility to know in real time the status of the seabed by displaying the underwater images and bathymetries. Thus, it could efficiently optimize time and cost of dredging operation avoiding unnecessary dredging steps.

IV. ACKNOWLEDGEMENTS

The Supervisor Dredging Equipment has been developed under the ECODRAGA project.

ECODRAGA project has received the financial aid of national government by a CDTI project in 2011, code ITC-20113086 and title DISEÑO Y DESARROLLO, ESTRUCTURAL Y DE SISTEMAS, MEDIANTE EL USO DE HERRAMIENTAS CAD, FEA Y CFD, DE UN PROTOTIPO DE DRAGA ECOLÓGICA PARA LA LIMPIEZA POR SUCCIÓN DE FONDOS MARINOS (ECODRAGA).

V. REFERENCES

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[2] Odroid Linux Computer. http://www.hardkernel.com

[3] Fielding, Roy Thomas (2000). "Chapter 5: Representational State Transfer (REST)". Architectural Styles and the Design of Network-based Software Architectures (Ph.D.). University of California, Irvine.