Allegato 1

Project proposal for the LABLAB development

The LABLAB (Laura Bassi Laboratory) is a facility within the OGS premises in Borgo Grotta Gigante established during 2023. In this space the ICT infrastructures of R/V Laura Bassi are tested and programmed before their deployment on board. Moreover the LABLAB has been a laboratory for the internship of Bastien Picco (student from ESEO, France) and hosts a computer with a permanent connection (through VPN) with the ship network.

This project aims to upgrade the Laura Bassi Laboratory (LABLAB) on land with an electronics hub to support and enhance the digital capabilities of the Research Vessel (RV) Laura Bassi.

In particular, the electronics hub of the LABLAB will focus on the development of:

- 'nearly expendable' probes
- staff training
- electronic devices of support

In the following paragraphs these objectives are described.

Development of 'nearly expendable' probes

The aim is to design and manufacture autonomous and remotely operated probes to support the research on the RV missions. The whole process, from conceptualization to realization and implementation should be carried on within the OGS research center and possibly within the LABLAB facility. The benefits from this upgrade are several. First, this would allow the RV to have available a large number of low cost probes that would increase the amount and type of data collected during a research campaign. Second, owning the whole designing process would allow the LABLAB team to customize the probes according to the needs dictated from the research objectives. Third, the above stated outcomes would result in highly versatile devices that could reach locations that are too risky and complex for other more expensive probes bought from the

market. Fourth, being the probes developed by the LABLAB team would allow it to perform any kind of repair or upgrade directly on the ship without the need of external technical support from land.

The probes designed would be considered in the following categories:

- AUV
- Gliders
- Benthic rovers
- Drones

Software development

The software development is an ongoing activity, which involves several topics relative to R/V Laura Bassi:
- Programming and setup of the research IT infrastructure
- Data acquisition, transmission, processing and storage
- Interfacing to other sensor networks (Valmet, Kongsberg, etc.)
- Integration with other archives and initiatives (e.g. Itineris)
- Development of UX/UI for the technical crew (intranet)
- Remote vessel controlling, digital twin
- Official website, dissemination projects

Staff training

The LABLAB, through the design of such probes, would allow the training in the respective areas of the technologists involved in the project. This would result in developing skills in CAD design, electronics, programming, manufacturing. The staff would therefore be trained to solve the typical challenges that might arise in a research campaign. Moreover, this would permit the opportunity for external visitors as trainees and interns to join the LABLAB projects enhancing the international aspect of the research center. To this account, the plan is to develop an internship plan with ESEO (École supérieure d'électronique de l'Ouest) from July to November where the intern will work in the design of a first prototype of a marine robotic system.

Electronic devices of support

Scientific equipment bought from the market might require an integration of data to be effective. The data to be integrated could be a GPS fix or a timestamp addition. The LABLAB should possess the equipment and knowledge to develop such kinds of devices on the RV.

Project milestones

- The first step is to furnish the LABLAB with basic electronic components together with Arduino boards to start developing the required circuits and codes for the probe operation. To this account, a list of electronic components to buy was already developed.
- Secondly the development of some remotely operated devices will be carried on to produce the design frame and pipeline for the future and more complex probe designs.
- Lastly, the design will be implemented with sensors and optimized to enhance the autonomy and the range of operation of the probes for the research campaigns.

First project plans

- **Remote Operated Vehicle for the inspection of underwater systems**. The device is operated remotely trough a data and power cable. The main purpose of the device is the ability to stream a video while it is underwater. Ideally the streaming of data can be viewed by a monitor on the ship while the ROV is being operated trough a controller. The maximum depth of operation could be set at 30 meters to allow for inspection of the ships hull.
  Essential components:
  Propellers
  Camera
  Lights
  Cabling
  Controller
  Data storage

- **ASV Autonomous surface vehicle (INTERSHIP)**. The device can either be operated remotely wireless or can be autonomous following a path of GPS data.
  Essential components:
  Wireless communications
  Propellers
  GPS receiver
  Transceiver
  Controller
  Power supply (battery)
  Data storage
  Camera?

- **GPS fixing device for airborne data collection**. Analysis in situ of greenhouse gasses suffers from its dependency from winds that occur during the acquisition. However by measuring the airplane heading throughout its flight can give an estimation of the wind intensity and direction. Several GPS receivers placed far apart on the airplane (cockpit,aft, wings) can give an accurate measurement of the heading of the vehicle.
  Essential components:
  Small monitor
  4 GPS receiver
  Power supply (Battery)
  Data storage

Future developments

Additional further activities will involve

- Robotics and automation
- Nearly expendable probes
- Deep learning for marine observations

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