ExpROVer - Milestone 1 - Client side

Interwater Explorers' team:

António José Santos   (81736)

Beatriz Borges Ribeiro (79857)

Gonçalo João Marques (80327)

João Pedro Monteiro   (80272)

Paulo Sérgio Gasalho   (84760)

Tiago Jorge Almeida   (76404)

Projeto em Engenharia Informática

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Version Control

Version	Date	Authors	Changes Log
V0.1	06/03/2019	António Santos (AS), Beatriz Borges (BB), Gonçalo Marques (GM), João Monteiro (JM), Sérgio Gasalho (SG), Tiago Almeida (TA)	First draft of the Introduction and Positioning sections.
V0.2	11/03/2019	BB	Addition of Client's Perspective section.
V1	16/03/2019	BB	Integration of project mentors' feedback.

Vision

1. Introduction

Remotely Operated Vehicles (ROVs) are underwater vehicles used across several sea- and ocean-related industries, for fish management, research purposes, dangerous maintenance operations and several other tasks.

The VideoRay Pro 4 (VRP4) is the world's most popular small underwater ROV. It incorporates the latest design and technology, making it stand out on the market as the most advanced, capable, and versatile small ROV.

Figure 1. VideoRay Pro 4.
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With a maximum depth of 300m, the VRP4 is controlled through an umbilical cord which directly connects it to a computer, which is used by the ROV to send data to the computer and to receive commands from it.

The VRP4 is controlled through the VideoRay Cockpit software, developed by VideoRay, executable only on Windows - and unfortunately known to be liable to problems and bugs.

Finally, this software requires training, being complex and demanding high levels of prolonged concentration from its users to ensure the proper maneuvering of the VRP4.

2.Positioning

In this section, the main problems and the project's locality are described.

2.1. Problem Statement

The problem of	operating a ROV or improving its functionality range
affects	all business and research institutions which require underwater monitoring or operations
the impact of which is	high labor costs, accidents' susceptibility and error-proneness during operations
a successful solution would be	the reduction of effort and inconvenience associated with operating a ROV, leading to lower expenses, higher efficiency and the enabling of new functionalities' creation.

2.2. Product Position Statement

For	owners of the VRP4
Who	want to control the VRP4 with either less specialized or more productive workers and have higher effectiveness in its operation
The ExpROVer	is a software solution
That	promotes a reduced workload and lower training requirements, offering several helper functionality and high accessibility to the ROV's systems.

Unlike	VideoRay's Cockpit software
Our product	will run on Linux, as well as Android, and will have several additional semi-autonomous features, such as object recognition and smart maneuvering.

3. Client's Perspective

3.1. Overview

Underwater exploration, system's management and maintenance, and research. At the tip of your fingertips.

There is no doubt that Remotely Operated Vehicles (ROVs) are one of the most important underwater tools in today's world. However, their proper maneuvering requires extensive training and is restricted by proprietary software.

The ExpROVer software will allow people from a myriad of backgrounds to easily operate the VideoRay Pro 4 (VRP4).

➔ It will be a **free, open-source software**, easy to modify and tailor to your needs

➔ It will feature **several smart functionalities not present in any other competing software**, like obstacles' detection and objects' recognition, as well as several semi-autonomous pre-programmed movements

➔ It will **support several devices and platforms, such as Linux and Android**, enabling mobility and paving the way for a larger community of developers and users.

3.2. Features

The ExpROVer system will allow you to easily, remotely, cheaply and efficiently operate your VideoRay Pro 4:

1.   Wirelessly monitor and control your ROV, from any device of your choice.

2.   Android and web applications enable remote control from a wide range of possible devices.

3.   Configure your ROV to have higher autonomy, by

    3.1.   automatically rising back to the surface,

    3.2.   following pre-programmed paths, and

    3.3.   maintaining a direction,

all while avoiding obstacles!

4.   Easily monitor fish farms, through the built-in object detection and recognition systems.

5.   All code is open source.

6.   Finally, if you are experienced with ROS (the Robot Operating System), you can even easily tinker existing code to add support for other functionalities and/or sensors specific to your needs!

3.3. Product Description

The ExpROVer is a software solution that will serve as a bridge between the user and the VRP4. It is comprised of 3 parts:

1.   One or more end devices, with the ExpROVer Mobile (android) or Web App,

2.   A server computer, connected to the ROV and running the ExpROVer backend application,
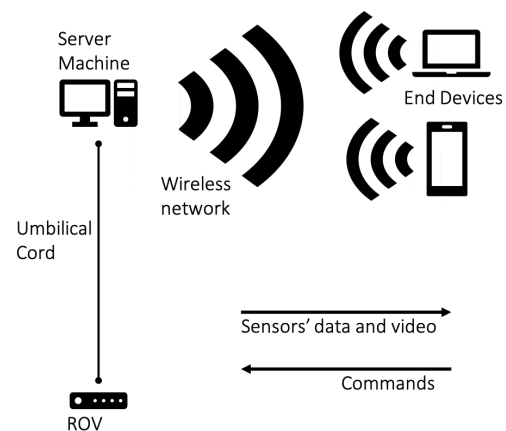
3.   And the VideoRay Pro 4 ROV.

Figure 2. A usage diagram.

For the communication between the end devices and the server machine, in the first release a wireless network will be used. However in subsequent work, the server could be deployed in the cloud, and the communication could be both wired or wireless.

To ensure the ExpROVer software's correct functioning, the server machine must be running on the Linux OS. There are no requirements concerning the end devices, only that they have wireless capabilities.

Besides the remote capability, an increased abstraction level will also be made possible for the

ExpROVer system. This abstraction will allow users to easily execute commands through semi-autonomous maneuvers, like rising to the surface, maintaining a direction, following a preprogrammed path and attempting to avoid obstacles. It will also reduce users' cognitive load by pre-processing the video's frames and detecting objects and fishes.
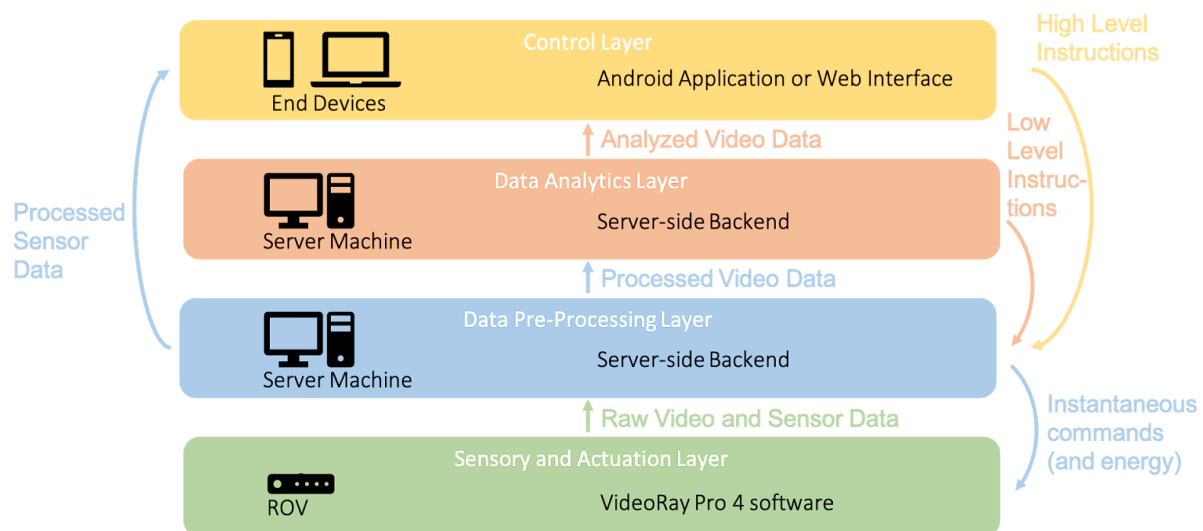

Figure 3. ExpROVer system's layered architecture.

Although not planned for the initial release, with the help of a beam laser as well as two lasers parallel to each other, the system will be able to estimate the distance to visible objects, as well as the size of several objects and fishes.

3.4. Schedule and Risks

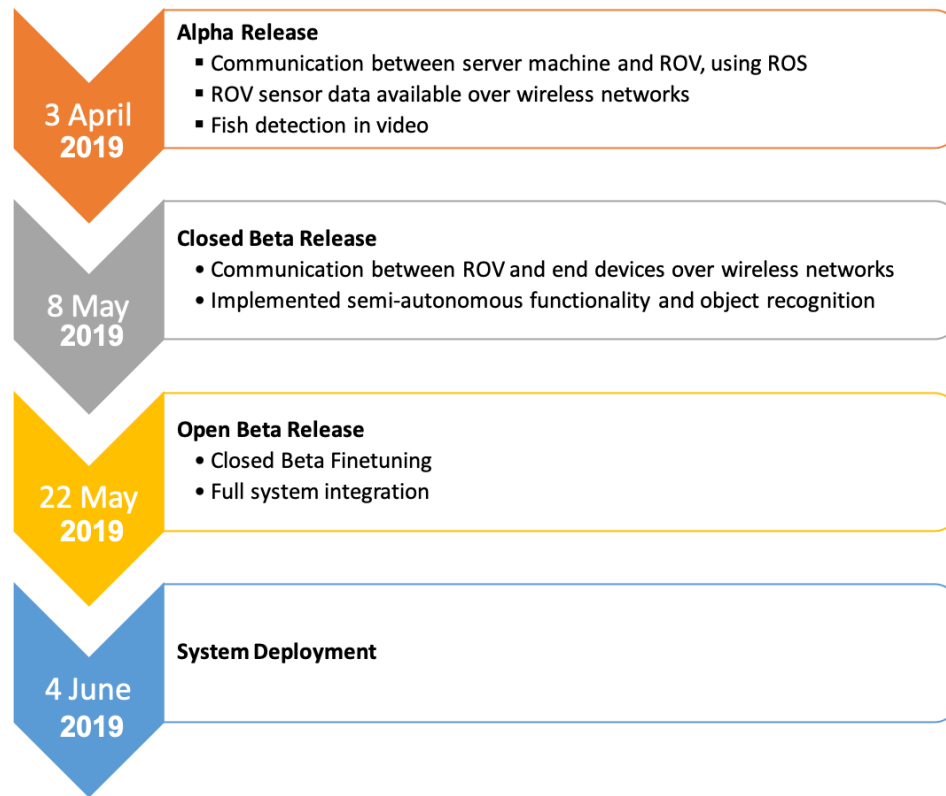The ExpROVer project's roadmap is depicted in Figure 4:

Figure 4. Project schedule.

The following table presents the main risks and challenges to the successful and timely implementation of this project as well as the mitigating actions to be taken:

Potential problems	Severity/Impact	Probability	Mitigation
ROV breaking/ malfunction	High	Low	Onboard of new partners that will be able to contribute to the acquisition of a new ROV
Insufficient VideoRay documentation	Medium-High	Medium	Consultation of other sources and experimentation.

Workforce shortage	High	Low	Recruitment of other members to the team

4. References

Several documents were consulted during the elaboration of this report:

1.   Pro 4 Operator's Manual, VideoRay, March 2019, available at

      http://download.videoray.com/documentation/pro_4/html/index.html

2.   Human-Automation Systems Lab general workspace, Georgia Tech ROS Group, March

      2019, available at https://github.com/gt-ros-pkg/humans