ExpROVer - Milestone 1 - Specifications

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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 Product Overview section.
V0.8	12/03/2019	AS, BB, GM, JM, SG, TA	Revision and update of the Product Overview 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. Product Overview

3.1. Features

FE# 1. Remote access to ROV through ROS

FE# 2. ROV control, anytime, anywhere, with any device with internet connectivity through a Web application

FE# 3. Specialized support for Android devices through an Android application

FE# 4. Several semi-autonomous maneuvers enablement

FE# 4.1. pre-programmed paths following,

FE# 4.1.1 straight line movement,

FE# 4.1.2 turn a given amount of degrees,

FE# 4.1.3 combinations of **FE# 4.1.1** and **FE# 4.1.2**, and

FE# 4.1.4 movement in a straight line until a change is detected in the video feed.

FE# 4.2. automatic return to the surface, and

FE# 4.4. direction maintaining.

FE# 5. Built-in object detection and recognition systems.

FE# 6. Fully open-source code, providing the possibility of alteration to suit more specific needs or features

3.2. Needs

The table below describe the solution needs, their priorities, features and planned releases.

Need	**Priority**	**Features**	**Planned Release**
Communication with VRP4 over ROS	High	FE# 1, FE# 6	Alpha release (3rd April)

Object and fish recognition	Medium	FE# 5	Alpha (3rd April) and Closed Beta (8th May) releases
Support for semi-autonomous maneuvers	Medium	FE# 4	Closed Beta (8th May) release
Control of ROV and leverage of the developed additional capabilities outside of Windows OS	Medium	FE# 1, FE #2, FE #4, FE #5, FE #6	Open Beta (22nd May) release
Remote control of ROV through an Android device	Low	FE# 1, FE# 2, FE# 3	Closed Beta (8th May) release

3.3. Business Requirements

To create the business model, various domains were succinctly described[1]:

Client segment	**1. Researchers** Use ROVs for underwater research and experiments. **2. Business owners** Use ROVs for underwater operations and maintenance. **3. IT-knowledgeable professionals** Familiar with ROS, they seek to leverage and operate in a new environment. **4. Hobbyists**

[1] Alexander Osterwalder, Yves Pigneur, Criar Modelos de Negócio, 2011

	Owning ROVs, they aim to take maximum advantage of them.
Value proposals	**1. Higher operational efficiency** Several helper functions reduce workload and concentration required to operate the ROV **2. Costs reduction** Less training required, fewer presential location requirements **3. Higher flexibility in control options** **4. User mobility in ROV data monitoring from anywhere, at any time**
Channels	Website for project advertisement Open source repository Social media
Client Relations	Digital touchpoints-based communication
Profit sources	Sponsorships and subsidies Donations
Key resources	VideoRay Pro 4 ROV, communications, Artificial Intelligence, Computer Vision, server, online application
Key activities	**1. Software development** a. For promotional website b. For ROS back-end on the server machine

	c. For data analytics layer d. For the Web and Android front-end on the end devices **2. Hardware integration** a. VRP4 integration with a Linux server machine running back-end program and wireless connection to the end devices **3. Graphical User Interface Design**
Key partners	VideoRay, universities and research institutes, fish farming and other underwater enterprises
Cost structures	VideoRay Pro 4, labor costs, server and processing units cost

3.4. Other Product Requirements

Requirement	Priority	Planned Release
Performance under environmental stressful conditions	Low	Open Beta (22nd May)
Security and data encryption	Medium	Open Beta (22nd May)
Near real-time ROV video analysis for object detection and recognition features	High	Closed Beta (8th May)
Dynamic path planning during maneuvers execution	High	Open Beta (22nd May)
d Backwards compatibility guarantee	Low	Open Beta (22nd May)

Meticulous usability practices to ensure great customer experiences	High	Closed Beta (8th May)
Detailed documentation of utilization practices in a User Manual	High	Alpha (4th April)

3.5. Project Risks

Potential problems	**Severity/Impact**	**Probability**	**Mitigation**
Requirements alterations	Medium	Low	Frequent meetings until a shared project vision is defined.
Delays and missed deadlines	Medium	Medium	Continuous effort monitoring and personnel reassignment to critical condition tasks.n
Difficulties in integration	High	Medium	Frequent meetings to normalize all communicating interfaces and overreaching architecture.
Rejected deliverables	High	Low	Meticulous and incremental products and processes adjustment and improvement.
Insufficient client adhesion	High	Low	Market and trends monitoring.

Different understandings of project vision	Medium	Medium	Frequent meetings until a shared project vision is reached, with well-defined requirements and scenarios.
ROV 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
3. Alexander Osterwalder, Yves Pigneur, Criar Modelos de Negócio, 2011