2nd Level Specializing Master's Programme in

ARTIFICIAL INTELLIGENCE & CLOUD:
HANDS-ON INNOVATION

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Design and Industrialization of a Robot Teleoperation System for Autonomous Inspection, Patrolling and Data Acquisition in Industrial Power Plants

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Abstract

Today's increasing availability of commercialized robots has opened up new opportunities for their use in many different industrial scenarios. One of the most famous among these robots available on the market today is Spot, a four-legged canine-inspired robot produced by Boston Dynamics. Spot is an agile mobile robot that navigates terrain with great mobility, allowing to automate routine inspection tasks and data capture safely, accurately and frequently. This work aims to present and detail the architecture and implementation of functionalities for the use of Spot within the industrial context of one of the world's largest multinational manufacturers and distributors of electricity and gas. More specifically, this work will address the application of robotics for the design and industrialization of a robot teleoperation system for autonomous inspection, patrolling and data acquisition in the industrial power plants of the aforementioned company. This project was carried out as part of a training internship conducted at Reply, a group of companies specialized in consulting, system integration and digital services. More specifically, it was carried out at Sprint Reply, the company of the Reply group specialized in robotic solutions.

Introduction

Robotics is an interdisciplinary field of computer science and engineering, emerged in the 1950s, which concerns the design, construction, operation, and use of robots. The goal of robotics is to design machines that can help and assist humans, integrating fields of mechanical engineering, electrical engineering, computer science, mechatronics, nanotechnology and bioengineering.[1] Robots are often employed for tasks that are repetitive, dirty and/or dangerous, with major applications in transportation, industry, healthcare, education, entertainment, space exploration, defence, retail, companionship, housekeeping and other areas. Because of its promising practical implications, robotics is considered today a discipline with great potential and high expectations, as well as one of the major frontiers of modern technology.

Among the many scenarios in which robotics is used, this work aims to present an application of robotics within the industrial context of one of the world's largest multinational manufacturers and distributors of electricity and gas. More specifically, this work will address the application of robotics for the design and industrialization of a robot teleoperation system for autonomous inspection, patrolling and data acquisition in the industrial power plants of the aforementioned company. This project was carried out as part of a training internship conducted at Reply, a group of companies specialized in consulting, system integration and digital services. More specifically, it was carried out at Sprint Reply, the company of the Reply group specialized in robotic solutions.

This work is organized in four chapters that aim to provide an initial description of the context and the tools involved, followed by a detailed discussion of the methodology designed to meet the imposed requirements, accompanied by the relevant experimental results. More precisely, the structure is as follows:

- Chapter 1 – Context and Objectives: this chapter provides an overview of the energy industry, with particular emphasis on the usefulness of

robotics within the context of the client company of reference. The project's goals and requirements are then introduced and detailed.

- Chapter 2 - Proposed Solution: this chapter addresses the hardware and software tools adopted to ensure the fulfillment of the project's requirements.
- Chapter 3 - Methodology: this chapter technically details the strategies and methodological choices adopted to ensure the fulfillment of the project's requirements.
- Chapter 4 - Experimental Results: this chapter presents and motivates the experimental results obtained at the end of the project, measured during multiple tests performed in real-world scenarios.

At the end of the last chapter of this work, a concluding section can be found, summarizing the results and contributions obtained through this project.