Integrative Project Assignment

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Abstract

This document comprises the Integrative Project Assignment detailed description of the practical work to be developed within ESOFT, MATCP, MDISC, PPROG, and LAPR2 courses. The work consists of developing an IT solution to support some of the critical tasks of an organization responsible for planning and maintaining green spaces for collective use. This document briefly introduces the business' domain and its sub-areas, the functional and non-functional requirements of the solution to be developed, the operating mode, i.e., the work approach, and the Integrative Project technical details.

Table 1: Version register

Version	Description
1.0	First version
1.1	Added sprint1 and Acceptance Criteria
1.12	Typos and minor errors corrected

Contents

1 Integrative Project

In this project, students should analyze, design and implement a computer solution to support the activity of an organization that is responsible for managing green spaces for collective use in predominantly urban contexts. Students must be organized in teams, and the proof-of-concept to be developed covers several critical aspects concerning the planning and maintenance of green spaces (such as gardens or parks), namely: multidisciplinary team management; allocation of teams to green spaces; fleet, machines and other equipment management; optimization of irrigation and/or lighting systems; production of statistical indicators that allow measuring the performance of the activity.

Following the good practices learned throughout the degree, and in particular in Software Engineering (ESOFT), Programming Paradigms (PPROG), Computational Mathematics (MATCP), Discrete Mathematics (MDISC) and Laboratory-Project (LAPR2) courses, this project implies applying an iterative and incremental development process. Therefore, an agile methodology based on SCRUM should be used to manage teamwork in each four-week SPRINT.

The software solution to be developed must be composed of a set of applications in Java that should accomplishes the the requirements. In order to increase the solution maintainability, and respect good software development practices, the implementation must follow a TDD (Test-Driven Development) approach.

2 Problem Statement: Description

The green spaces for collective use, often referred to as gardens and parks, are fundamental for people's quality of life, especially in urban or semi-urban contexts. Currently, their need, location, and dimensions are stipulated in the general law and are an integral part of Municipal Master Plans. Contact with nature is an essential element for the well-being of the population in general. This contact was natural and obvious until

the Industrial Revolution, after which there was a significant migration of populations from rural to urban areas. According to a 2022 UN report, at the current rate, it is expected that the concentration of the world's population in urban areas will increase from 56% to 68% by the year 2050, which in urban contexts translates into an increase of 2.2 thousand million people. The Portuguese reality does not differ much from the global context.

In democratic and liberal systems, such as the Portuguese, citizens naturally demand the existence of green spaces in both quantity and quality suitable for the size of the population. Therefore, the proper management of these spaces is of great importance.

Green spaces for collective use can vary significantly in dimensions and available amenities. They may range from small landscaped areas, parks with trees and some amenities like benches or playgrounds, to parks with multiple hectares (e.g., in Porto, there are the Parque da Cidade - City Park - the Parque Oriental - the Oriental Park), wooded areas, lakes, and various facilities and installations.

MusgoSublime (MS) is an organization dedicated to the planning, construction and maintenance of green spaces for collective use in their multiple dimensions, namely: plant material (e.g. flowers, shrubs, trees); urban furniture (e.g. benches, tables, gymnastics equipment); irrigation systems and drinking fountains; lighting systems and the respective power supply; rainwater conduction and drainage systems. In the context of the current project MS will provide the requirements for the proof-of-concept to be developed.

2.1 Green Spaces for Collective Use

The green spaces for collective use managed by MS can significantly vary in size and installed equipment:

- Garden - garden space with or without trees with little or no equipment (may have a basic irrigation system or sitting benches);

- Medium-sized park - green space with a few hundred or thousands of square meters with a wooded garden area, it includes some infrastructures such as toilets, drinking fountains, irrigation system, lighting, children's playground (for example, Quinta do Covelo, Jardim de Arca de Água);

- Large-sized park - multi-function space with diverse garden spaces, and woods, including varied equipment and services (for example, Parque da Cidade).

2.2 Collaborators, tasks and teams

MS has a wide range of employees who carry out the most varied tasks in the context of designing and managing green spaces. Some job examples are designer, budgetist, gardener, electrician or bricklayer. Thus, an employee has a main occupation (job) and a set of skills that enable him to perform/take on certain tasks/responsibilities, for example, driving vehicles of different types (e.g. light, or heavy), operating machines such as backhoes or tractors; tree pruning; application of agriculture phytopharmaceuticals.

Tasks are carried out on an occasional or regular basis in one or more green spaces, for example: tree pruning; installation of an irrigation system; installation of a lighting system.

Teams are temporary associations of employees who will carry out a set of tasks in one or more green spaces. When creating multipurpose teams, the number of members and the set of skills that must be covered are crucial.

2.3   Vehicles, machines and equipment

Vehicles are needed to carry out the tasks assigned to the teams as well as to transport machines and equipment. This type of vehicle can be only for passengers or mixed, light or heavy, open box or closed vans or trucks.

As for machines, MS has tractors, backhoe loaders and rotating machines, lawnmowers, among others. The equipment can be greatly diverse, such as sprayers, lifting platforms, chainsaws, brush cutters, blowers, ladders, cisterns and the various elements that can be attached to tractors, such as disc harrows, weeders, aerators and scarifiers

2.4   Agenda

The Agenda is a crucial mechanism for planning the week's work. Each entry in the Agenda defines a task (previously on the to-do list) that will be carried out by a team in a green space at a certain time interval on a specific date. Comparatively analyzing the Agenda entries and the pending tasks (to-do list) allows you to evaluate the work still to be done, the busyness of the week, and the work performed by a team in a green space at a determined time interval and on a specific date.

2.5   Green Spaces User Portal

The green spaces management aims, within the available budget, to design, build and maintain parks and gardens that meet the requirements of the commom citizen who wants to be informed. With this in mind, the objective is to develop a Portal in which parks and garden users can post comments, and report faults and malfunctions of equipment.

2.6   System Users

This system may potentially be used by multiple users, namely:

- Human Resources Manager (HRM) - a person who manages human resources and defines teams based on the needs of ongoing projects and the skills of the employees.

- Vehicle and Equipment Fleet Manager (VFM) – a person who manages the fleet park, the machines, equipment and vehicles, ensuring their good condition and assigning them to the tasks to be carried out.

- Collaborator – a person who is an employee of the organization and carries out design, construction and/or maintenance tasks for green areas, depending on their skills.

- Green Spaces Manager (GSM) - the person responsible for managing the green spaces in charge of the organization.

- Green Spaces User (GSU) - a person who uses the green spaces managed by the organization and who can through the Portal, make comments or report faults in parks and gardens on the Portal.

3 Minimal Viable Product (PVM)

The purpose of this project is to develop a Minimal Viable Product iteratively and incrementally; therefore the work is divided into three Sprints:

- Sprint 1 – Weeks 3 to 6 – from 4/March to 7/April

- Sprint 2 – Weeks 7 to 10 – from 8/April to 12/May

- Sprint 3 – Weeks 11 to 14 – from 13/May to 9/June

A description of the PVM is provided for each sprint. Teams must follow the user stories (USs) provided and take into account their interconnections and respective dependencies and at the end of each sprint each team must be able to meet the specified requirements. Teams must be able to add USs to the backlog, size them appropriately, and distribute them across team members.

3.1 Sprint 1

This Sprint targets developing the following US (Requirement Engineering and Analysis):

- US01 - As a Human Resources Manager (HRM), I want to register skills that a collaborator may have.

- US02 - As an HRM, I want to register a job that a collaborator need to have.

- US03 - As an HRM, I want to register a collaborator with a job and fundamental characteristics.

  - AC1: name, birthdate, admission date, address, contact info (mobile and email), ID doc type and respective number should be provided by HRM

- US04 - As an HRM, I want to assign one or more skills to a collaborator.

- US05 - As a HRM, I want to generate a team proposal automatically.

  - AC1: The maximum team size and the set of skills need to be supplied by the HRM

- US06 - As an FM, I wish to register a vehicle including Brand, Model, Type, Tare, Gross Weight, Current Km, Register Date, Acquisition Date, Maintenance/Check-up Frequency (in Kms).

- US07 - As an FM, I wish to register a vehicle's check-up.

- US08 - As an FM, I want to list the vehicles needing the check-up.

For Sprint 1 (aka Sprint A), regarding the Requirements Engineering activity:

- teams with 4 or more students enrolled in ESOFT must elaborate all user stories;

- teams with 3 or less students enrolled in ESOFT must only elaborate user stories related to "Collaborators, tasks and teams" (i.e. US01 to US05).

3.2   Sprint 2

3.3   Sprint 3

3.4   Non-functional requirements

This section describes some of the non-functional requirements that must be considered when implementing the project.

- Business rules validation must be respected when recording and updating data.

- The class structure must be designed to allow easy maintenance and the addition of new features, following the best OO practices.

- The application must be developed in Java language using the IntelliJ IDE or NetBeans. The application's graphical interface is to be developed in JavaFX 11. All those who wish to use the application must be authenticated with a password of seven alphanumeric characters, including three capital letters and two digits.

- The application documention must be in English language.

- During the system development, the team must: (i) adopt best practices for identifying requirements, and for OO software analysis and design; (ii) adopt recognized coding standards (e.g., CamelCase); (iii) use Javadoc to generate useful documentation for Java code.

- The development team must implement unit tests for all methods, except for methods that implement Input/Output operations. The unit tests should be implemented using the JUnit 5 framework. The JaCoCo plugin should be used to generate the coverage report.

- All the images/figures produced during the software development process should be recorded in SVG format.

- The application should use object serialization to ensure data persistence between two runs of the application.