



UNIVERSIDAD DE GUADALAJARA
CENTRO UNIVERSITARIO DE LOS VALLES

Software Configuration Management

**System for the Inspection of a Photovoltaic Park with
Aerial Images in High Definition and Thermal**

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SCM-SIPaF-V0.1

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1. Introduction

With the purpose of simplifying and making more efficient the process of detecting failures in solar panels within photovoltaic plants, thus testing the system within CUValles in Ameca, Jalisco; It is proposed to develop this project for the analysis of high definition images and thermal images taken from a drone.

Fault detection tracking without software for analyzing the status of solar panels within the plant is a problem because of the way the electrical interconnections of the solar panels are made. The process is time-consuming and may be subject to human error. This process is carried out as follows:

1. Detection of low production in a sector within the plant.
2. Sending a specialized team or drone to monitor the panels in that place.
3. Analyze the data or images obtained.
4. Identify the position of the damaged panel.
5. Deliver the validation document to the team in charge of repairing the damage.

1.1 Purpose

The objective of this document is to define the specification of the functional and non-functional requirements, as well as the objectives that need to be done for the acceptance of the system that will help to inspect the state of the solar panels using aerial images taken by a drone.

1.2 Scope of the system

Develop a system to support the Master's in Software Engineering to monitor the academic performance of students in their semester thesis progress. The development of this specific system is contemplated for this postgraduate course at the University Center of the Valleys of the University of Guadalajara, with exposure outside the university network for external reviewers.

1.3 Definitions and acronyms

Term	Definition
SIPaF	System for the Inspection of a Photovoltaic Park
SCM	Software Configuration Management
MIS	Master Degree in Software Engineering
CUValles	Centro Universitario de los Valles

1.4 Document Overview

In order to guide the reader, this document is organized into the following sections:

The introduction provides background information and important factors to consider in the solar panel inspection process.

The second section offers a general description of the system, where the general factors included in the product and its requirements are described. The stakeholders to whom this section of the document is addressed are the users involved and the system development team. Users will be able to identify the functionalities of the system and developers will be able to understand the software and communications restrictions under which development will proceed.

Finally, in the third section, the specific requirements of the system and the follow-up that they will have during the development of the project are described. The elements are grouped into functional and non-functional requirements, in such detail that it facilitates the work of the development team using a natural and simple language, in order to integrate all the stakeholders of the project within the process of building the software product.

2. General description

This section specifies the factors of interest and the functional requirements of the SIPaF system. To achieve this, it will be necessary to make a detailed description of the environment where the system will be implemented, and the factors involved in the application space. In this way, this collected information will provide the guidelines for the development and implementation of this software.

2.1 Product perspective

The desktop application of System for the Inspection of a Photovoltaic Park(SIPaF) aims to be a tool to improve the current process of inspection and detection of production failures of photovoltaic panels in a solar plant for the university campus of Valleys located in Ameca, Jalisco.

2.2 Product features

The SIPaF system intends to make use of technological tools to achieve the objective set by the client, in this case, the project director, Dr. Himer Avila George. For this they are necessary: the analysis, design of the system, as well as the database and the user interface.

Broadly speaking, the product will allow the following functionalities:

1. Enter aerial images in high definition and thermal images.
2. Make an orthomosaic of the place with the two types of images.
3. Identify each of the solar panels in the orthomosaics.
4. Determine which panels have faults and give them a priority level.
5. Make a report with the data obtained.
6. Help to better visualize the data obtained from the plant in each report.

2.3 User

This section describes the type of user that will make up the system. A single user is contemplated who can share this information with other people through emails.

Type of users	Description	Privileges	Technical Experience	Frequency of use
User	User who has permissions to create projects, upload images, make reports and view information. Also, he must be able to share the information using an email. The images cannot be shared, but the results of the reports can.	Access all the functionalities of the system.	Advanced Basic system administration skills with significant application knowledge are required.	Whenever required.

2.4 Restrictions

- The SIPaF system will be designed in python and as a desktop application.
- The application's operating system will be Windows 11 64-bit and its code will be in Python with version 3.9.7.
- Users will need to have the program installed on their hard drive.
- The response speed is determined by the computer's processor and graphics card.
- Access to the system will not be restricted, but a password will be requested when registering an email for sending files.

2.5 Assumptions and dependencies

- The system requirements can change during the development of the application only if they follow the SCM policies.
- Availability of development team work.
- Time availability of project stakeholders.
- It will be necessary to validate the operation of the software with an expert for its full implementation.

3. Specific requirements

In this section you will see all the client's needs to accept the product as a quality product.

3.1 External interfaces

3.1.1 User interfaces

The user interface will have a set of windows with buttons, lists and text fields. The user interface will be displayed when the program is run. To access the interface, you must have the program installed on your hard drive.

3.1.2 Software Interfaces

- Desktop Application: Windows 11 64-bit.

3.2 Functional Requirements

This section will describe the system requirements in detail as shown in the following tables:

1. User: Create project
2. User: Delete project
3. User: Modify project
4. User: Search file
5. User: Create report
6. User: Delete report
7. User: Set email account
8. User: Change email account
9. User: View reports
10. User: Create orthomosaics
11. User: Share obtained reports
12. User: Print reports
13. User: View graphs from projects data
14. User: Save the graphs created
15. System: Identify the faults from the images

3.2.1 Functional requirements tables

Functional Requirements Specification			
Code	Name		Degree of need
RF-01	Create project		High
Description	The user needs to create a project in which he can have the information obtained from that analysis.		
Inputs	Source	Outputs	Restrictions
+Project name +Address +Images for processing	User	>Project display in the organization bar.	*If the project already exists, a notification will be sent to the user to know if they want to replace it.

Process	New project must be selected in the file menu or in the project display area. Then you must choose the location to save the project. Next is to select the images for analysis.
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Functional Requirement Specification			
Code	Name		Degree of need
RF-02	Delete project		High
Description	The user needs to delete the files created by the system of a project already created so that it does not appear in the system.		
Inputs	Source	Outputs	Restrictions
+Project	User	>Deletion of the project from the organization bar.	*Choose a project that has been created.
Process	Must select an already created project and then select the delete option. The image analysis file will be deleted, but the created reports will not be deleted.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-03	Modify project		Medium
Description	The user can select an existing project and remake the process changing the images used.		
Inputs	Source	Outputs	Restrictions
+Project Parameters	User	>Redoes the project replacing all the information it had.	*Requires a finished or failed project.
Process	Must select an already created project and then select the start option after checking the parameters for the process are correct. The products of the project will be deleted to create the new ones.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-04	Search file		Medium
Description	The user searches for a project or report in the display bar where the files of the working directory are displayed.		
Inputs	Source	Outputs	Restrictions
Project name Report name	User	>Displays the project that matches with the search and is found in the project folder.	*The project must have the characters specified on their name.
Process	Must select the search bar above the display bar and type the characters of the name that are on the project.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-05	Create report		High
Description	The user can create a report of the information gathered by the project in a PDF format.		
Inputs	Source	Outputs	Restrictions

+Project Name of the report.	User	>PDF file of the report on the display bar.	*The report will be created in the same directory as the project..
Process	Must select a finished project and then select the make report option. The display bar is updated when the process finishes and a message is displayed..		

Functional Requirements Specification			
Code	Name		Degree of need
RF-06	Delete report		Medium
Description	The user can delete from the project's folder a report created.		
Inputs	Source	Outputs	Restrictions
+Report	User	>PDF file of the report on the display bar is removed.	*The report will no longer exist..
Process	Must select a report and then select the delete report option. The display bar is updated when the process finishes and a message is displayed..		

Functional Requirements Specification			
Code	Name		Degree of need
RF-07	Set email account		High
Description	Configure an email on the system.		
Inputs	Source	Outputs	Restrictions
+Email +Password	User	>Message displaying the status.	*Can only have one email configured at the time.
Process	Provide a valid account and wait for the system to verify it.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-08	Change email account		High
Description	Change to another email account.		
Inputs	Source	Outputs	Restrictions
+Email +Password	User	>Message displaying the status.	*Can only have one email configured at the time.
Process	Must select the settings and then change the email account option. Then provide the last email and password account. If valid, must provide a new valid account and wait for the system to verify it.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-09	View reports		Medium
Description	Open a report created by selecting it.		
Inputs	Source	Outputs	Restrictions

+Report	User	>Opens the report on another application that visualizes PDFs.	*Won't be able to see it on the system.
Process	Must select a report and select the option to open it. Then a PDF reader application will be open with the report.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-10	Create orthomosaics		High
Description	Create an orthomosaic if selected with the images for the analysis.		
Inputs	Source	Outputs	Restrictions
+Images RGB Thermal	User	>Shows the orthomosaic on the display bar.	*Can only do it if selected during the analysis..
Process	Must select the option when creating a project and start the project. The orthomosaic will be made in the RGB and Infrared images if selected. They will be displayed on the view tab.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-11	Share obtained reports		High
Description	The reports obtained can be shared through email.		
Inputs	Source	Outputs	Restrictions
+Report +Email account(s)	User	>Displays an image after sending the report.	*The system will not check if the email was received. *The system won't verify if the destination account is valid. *A valid email must be active on the system.
Process	Must select a report and select the option to share it. Then the destination emails must be entered.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-12	Print reports		Medium
Description	Be able to send the report to a printer.		
Inputs	Source	Outputs	Restrictions
+Report +Printer	User	>Displays a message after sending it to the printer.	*Won't verify if it was printed already.
Process	Must select a report and select the option to print it. Then a printer must be selected and send it print.		

Functional Requirements Specification		
Code	Name	Degree of need
RF-13	Create graphs from projects data	High

Description	Let the user select multiple projects to compare the data from them and visualize them.		
Inputs	Source	Outputs	Restrictions
+Projects	User	>Displays a graph with the data obtained on the data bar.	*There will be a limit of 20 projects.
Process	Must select multiple projects and select the option to make a graph. The graph will be displayed on the data bar and some options will be available to modify some parameters of the graph.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-14	Save the graphs created		High
Description	Let the user save the graph created.		
Inputs	Source	Outputs	Restrictions
+Graph +Address	User	>Displays a message after saving the graph.	*The graph won't be linked to a project.
Process	Must select a graph and select the option to save it. The graph will be saved on the address specified and can be opened from there.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-15	Identify the faults from the images		High
Description	Must be able to locate the faults in the images selected from the user.		
Inputs	Source	Outputs	Restrictions
+Images +Trained model	User	>Displays all the data of the process using images and text labels in the system.	*The data must be displayed in a good way in the system.
Process	After creating a project and started the process, the system must be able to identify the faults within the images presented and display them in an organized form within the system screen.		

3.3 Nonfunctional Requirements

3.3.1 Performance requirements

The system must have a database manager.

The system must have an optimal response time.

3.3.2 Reliability Requirements

The system must be reliable.

The system must warn against possible erroneous operations or actions.

3.3.3 Availability Requirements

The system must be available 100% of the time.

The system must be able to identify the projects created and displaying them if they are on the same working directory.

3.3.4 Maintainability Requirements

The system must have parameterizable characteristics to allow future maintenance (source code).

The system should be created in such a way that modules or updates can be added in the future.

3.3.5 Portability Requirements

The system must be able to be installed and used on any Windows 11 system.

3.3.6 Design Restrictions

The system must be intuitive.

The system must have a logo.

The system must have text-type aids in the forms.

3.3.7 System Attributes

The system must be able to send emails.

3.3.8 Other requirements

The system does not interact with another external system.

The system must have an intellectual property and be registered in INDAutor.