Università degli Studi di Salerno

Corso di Laurea in Informatica

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1. DOCUMENT STRUCTURE

1.1 PROBLEM DOMAIN

1.2 PROPOSED SYSTEM

In this section, the main aspects of the application will be described, such as:
- Functional requirements: definition of the functions of the system.
- Non-functional requirements: specific constraints, not directly related to system functionality, such as usability or performance restrictions.
- Scenarios: fictitious stories of a user's experience with the system.
- Use case model: a model depicting the interaction between the actors and the application;
- Interface mock-ups: an early sketched prototype of the user interface.

1.3 DEFINITIONS AND ACRONYMS

AI: Artificial Intelligence;
AR: Aumented Reality;
TTS: Text-To-Speech;
UC: Use Case;
UML: Unified Modeling Language;

2. PROBLEM DOMAIN

When visiting a museum or an art gallery, inspecting a painting is limited to a quick visual analysis and, in some cases, to a small description found on a plate next to it; for the most part, the history behind it and some details get lost and forgotten.

A guide can help with expanding this knowledge, however guided tours are often not included in the ticket price and they … long routes, or are not avaliable at all, like in small private galleries. Any language barrier doesn't make it easier.

Besides, often visiting a museum is not an option for art enthusiasts or young people and online information is frequently scattered and incomplete.

3. PROPOSED SYSTEM

3.1 OVERVIEW

Today's technology easily allows us to perform a deeper interaction with the reality around us, in ways we never imagined before. This interaction can be extended to the artistic world …

The application aims to deliver an enhanced educational experience through the usage of Augmnented Reality and Artificial Intelligence technology, in order to provide the user with additional information about a painting or help visually impaired people receive auditive aid. Anyone with a supported device can come across new ways to appreciate art and even discover new details in an evocative piece.

After launching the application, a user will have the ability to scan a painting by using their smartphone's integrated camera; if the image is recognized, the system will then lookup its associated information and generate a virtual copy of the painting, along with a guide, using AR. The guide will begin interacting with the user via Text-To-Speech, by narrating the details of the painting and highlighting them on the generated copy, when possible.

If either the scanning process or the lookup were to fail, the user would be notified and could repeat the process.
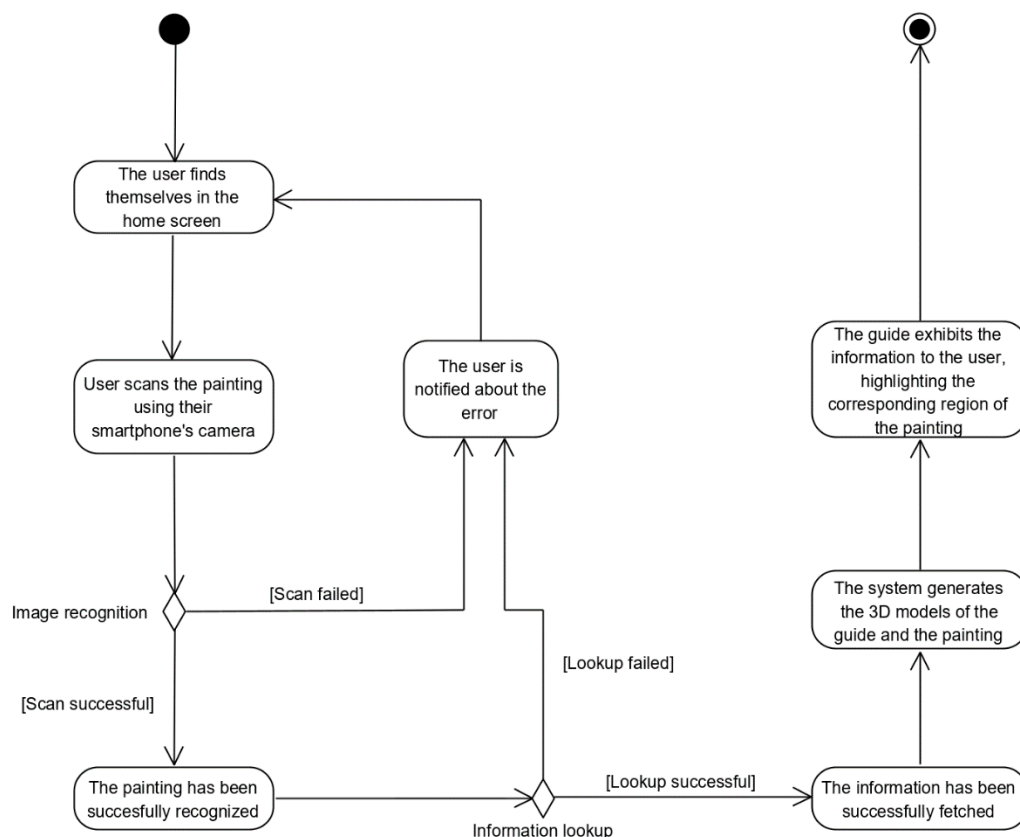

Figure 1 UML activity diagram depicting the interaction between a user and the system.

3.2 VIRTUAL GUIDE AND PAINTING

After recognizing a painting, the sistem will generate a virtual guide, a 3D model of the artist's head and it will communicate with user using TTS

The generated painting's surface will be divided into independent regions, used to highlight the information provided by the guide. When focused, these regions will be extended forward, towards the user, while the others will be blurred out.

3.3 GOALS OF THE SYSTEM

The system aims to achieve the following goals:
- Enhance the educational experience for students and art enthusiasts.
- Create an alternative to traditional museum guides.
- Aid visually impaired people experience art.

3.4 FUNCTIONAL REQUIREMENTS

- **FR_1**: The system must allow the user to scan a painting, identifying it via image recognition.
- **FR_2**: The system must be able to retrieve the information associated to a scanned painting.
- **FR_3**: The system must be able to project an augmented reality guide.
- **FR_4**: The system must be able to project an interactive virtual copy of the painting, used to highlight the information exposed by the guide.
- **FR_5**: The system must utilize TTS technology when providing the user with the requested information.
- **FR_6**: The system must provide the possibility to use subtitles for the guide's voice.
- **FR_7**: The system must allow an administrator to add a new painting and its related information to the archive.

3.5 NON-FUNCTIONAL REQUIREMENTS

3.5.1 USABILITY

- **NFR_U1**: The system's interface must be easy to use and not ambiguous.
- **NFR_U2**: The system must ensure operations are performed in the most direct way avaliable.
- **NFR_U3**: The system must include a user manual.

3.5.2 RELIABILITY

- **NFR_R1**: The information provided by the system must always be reliable and consistent.
- **NFR_R2**: The system must ensure any error message is delivered to the user in less than 3 seconds.

3.5.3 PERFORMANCE

- **NFR_P1**: System response time must not exceed 300ms when performing lookup operations.
- **NFR_P2**: Errors related to … must not exceed the threshold of x occurrences per month.

3.5.4 SUPPORTABILITY

- **NFR_S1**: The system must include an exhaustive documentation, in order to more easily support maintenance.

3.5.5 IMPLEMENTATION

3.5.6 LEGAL

3.6 SCENARIOS

Scenario name	MuseumUsage
Scenario ID	SC_1
Participants	Ann: art student visiting the Salvador Dalí Museum in Figueres with her class.
Flow of events	1. Ann is wandering into the halls of the museum when a particular piece catches her eye, Palladio's Corridor of Thalia, so she gets closer and starts examining it. 2. The girl isn't satisfied with the little information provided by the plate next to the painting and wants to know more. 3. Ellie, one of Ann's classmates suggests her …, to quench her thirst for more details. 4. Ann decides to give it a try, so she downloads the app and, after reading the manual, tries to scan the painting using her smartphone. 5. The system recognizes the painting and proceeds to generate its virtual copy, along with an interactive talking head of the artist, in the space in front of Ann, using AR. 6. The artist then begins to narrate the story of the painting to Ann, in particular he tells Ann how the piece is heavily influenced by italian Renaissance art. 7. Moving to the painting itself, the guide starts to speak about the strongly lit figure og a girl playing with a skipping rope in the top left, while the corresponding region is projected forward in the virtual painting.

Scenario name	HomeUsage
Scenario ID	SC_2
Participants	Frank: art enthusiast working from home during quarantine.
Flow of events	1. After being stuck at home for more than three weeks, Frank decides to ... his old photo book. 2. While browsing the pages, the man notices a picture of him next to "The Bedroom" by Vincent Van Gogh, snapped during a trip some years ago. 3. Frank decides to use … to try and get more info on the painting in the picture, so using his phone he scans it. 4. The system correctly recognizes it and proceeds to generate a copy of the painting and the guide, which begins narrating the details of the painting to Frank.

Scenario name	AdminUsage
Scenario ID	SC_3
Participants	
Flow of events	

3.7 USE CASE MODEL
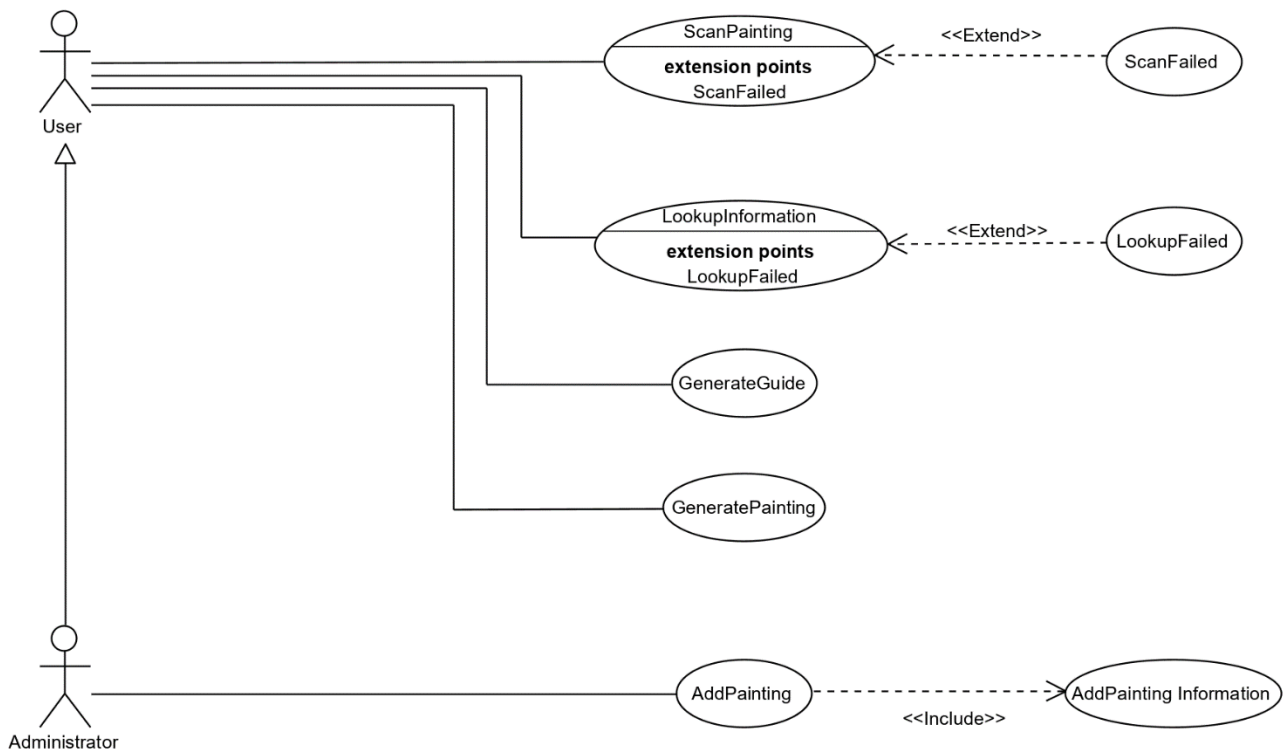
Figure 2 UML Use Case Diagram of the system

Use case name	ScanPainting
Use case ID	UC_1
Participating actors	User
Preconditions	1. The user finds themselves in the home screen
Flow of events	1. The user points the camera towards the painting. 2. The system begins looking for a match of the painting.
Postconditions	The scanning process was successful and the user is waiting for the system to lookup the associated information.
Exceptions	2.1. The system cannot find any match for the painting (Use case "ScanFailed" – UC_1.1).

Use case name	ScanFailed
Use case ID	UC_1.1
Participating actors	User
Preconditions	The system cannot find any match for a painting.
Flow of events	1. The system notifies the user about the error.
Postconditions	The user is redirect in the home screen of the application.

Use case name	LookupInformation
Use case ID	UC_2
Participating actors	User
Preconditions	A painting has been successfully scanned and the user is waiting for the system to lookup the associated information.
Flow of events	1. The system retrieves the painting information in its internal archive.
Postconditions	The system is able to retrieve the requested information.
Exceptions	1.1. The system cannot find any information for the matched painting (Use case "LookupFailed" – UC_2.1).

Use case name	LookupFailed
Use case ID	UC_2.1
Participating actors	User
Preconditions	The system cannot find the information associated to a scanned painting.
Flow of events	1. The system notifies the user about the error.
Postconditions	The user is redirect in the home screen of the application.

Use case name	GenerateGuide
Use case ID	UC_3
Participating actors	User
Preconditions	User has scanned a painting and the system has correctly recognized it and has retrieved its associated information.
Flow of events	1. Based on the scanned painting's author, the system retrieves the 3D model of the guide to display and projects it in the space pointed by the user.
Postconditions	The 3D guide has been successfully generated in the application.

Use case name	GeneratePainting
Use case ID	UC_4
Participating actors	User
Preconditions	User has scanned a painting and the system has correctly recognized it and has retrieved its associated information.
Flow of events	1. Based on the painting size and information retrieved, the system creates a grid used to highlight the details of the piece. 2. The system then displays and projects the in the space pointed by the user, next to the guide.
Postconditions	The virtual copy of the painting has been successfully generated in the application.

Use case name	AddPainting
Use case ID	UC_5
Participating actors	Administrator
Preconditions	The administrator requests the form to add a new painting.
Flow of events	1. The admininistrator compiles the form with the painting image and the information associated to the it (Use Case "AddPaintingInformation" – UC_6)
Postconditions	The new painting has benn successfully added to the archive and will now be recognized when scanned.

Use case name	AddPaintingInformation
Use case ID	UC_6
Participating actors	Administrator
Preconditions	An administrator is adding a new painting to the archive
Flow of events	
Postconditions	The

3.8 USER INTERFACE MOCK-UPS