

D2.1 Use Case Scenario Definition

Due date: **31/10/2023**

Submission Date: **07/11/2023**

Start date of project: **01/07/2023**

Duration: **36 months**

Lead organisation for this deliverable: **Carnegie Mellon University Africa**

Responsible Person: **D. Vernon**

Revision: **1.1**

Project funded by the African Engineering and Technology Network (Afretec) Inclusive Digital Transformation Research Grant Programme		
Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including Afretec Administration)	
RE	Restricted to a group specified by the consortium (including Afretec Administration)	
CO	Confidential, only for members of the consortium (including Afretec Administration)	

Executive Summary

This deliverable represents the outcome of Task 2.1. It presents a detailed scenario definition for the two use cases: lab tour guide and receptionist. It describes the aim of the use case, the setting, the procedure, and the measurable variables. It provides the basis for the robot behavior specification (D2.2) and the visitor behavior specification (D2.3). The report includes a walk-through of the scenario, providing a decomposition into a time sequence of elementary robot actions. For each action, the deliverable specifies the set of triggers for the action, e.g., input from visitor using speech, spatial movement, or the tablet PC on the robot, and the sequence of movements, expressions, or vocal output that constitute the robot actions.

The report does not detail the layout of the environment in which the scenarios are set as this will depend on the local situation while will be mapped automatically by the Pepper robot during a set-up phase.

Contents

1.	Use-Case Scenario Methodology	4
2.	Use-Case Scenario Specification	4
3.	Use-Case Scenario 1: Lab Tour	5
4.	Use-Case Scenario 2: Receptionist	7
	Principal Contributors	9
	Document History	10

1. Use-Case Scenario Methodology

This document defines the two use cases in which the culturally sensitive social robot behavior will be demonstrated: lab tour guide and receptionist.

It does this by setting out the aim of the use case scenario, the setting, and the procedure using a structured walk-through of all the interactions that instantiate the scenario. The purpose of the walk-through is to unwrap the interaction in each use case into micro-steps of elementary robot perceptions and actions and actions, and actions by the interaction partner, i.e., the visitor.

On the basis of this unwrapped timeline of elemental perceptions and actions, we then identify in Deliverable D2.3 the measurable sensory indicators required to parameterize and quantify the information about the visitor that is necessary to allow the robot to interact effectively (i.e., in a culturally sensitive manner) with her or him, e.g., locating the position of the visitor, their face, and eyes.

The main form of interaction by the human will be through limited spoken requests and instructions, implemented with automated speech recognition, and, if necessary, the tablet PC on the robot. This unwrapped walk-through provides the baseline data for tasks T2.2 and T2.3.

2. Use-Case Scenario Specification

The next two sections set out a detailed decomposition of each use-case scenario. These decompositions are relatively straightforward but do contain a lot of information. To make it easier to read, the parts of the decomposition – actions, movements and sensory cues, sensory-motor processes, and comments – are colour-coded.

The actions (**in green**) define the interaction tasks in a relatively abstract and intuitive manner.

The component movements and sensory cues (**in black**) make explicit all of the constituents of each action. The component movements and sensory cues always refer to the robot's perspective, i.e., they define what the robot does and what the robot sees and hears.

The sensory-motor processes (**in red**) provide the essential input for the definition of robot behaviour specification (Deliverable D2.2) and the visitor behaviour specification (Deliverable D2.3).

The comments (**in blue**) add simple explanations of what is happening in the task at that point.

Note that no cultural knowledge is embedded in either use-case scenario specification. This knowledge will be included after it has been identified in Tasks 1.1 and 1.2, formalized in Tasks 1.3 and 1.4, and encapsulated in a knowledge base in Task 5.4.1.

3. Use-Case Scenario 1: Lab Tour

The robot stands at the entrance to the Robotics Laboratory, actively waiting to engage with a visitor.
In this scenario, we assume the visitor approaches the robot.

Launch the application

REPEAT

REPEAT

The robot makes natural movements

Adjust gaze and sway gently, flexing hands slightly

Animate behaviour

The robot looks for a person approaching

Try to detect a human body

Try to detect a face

IF a face or a body is detected

Determine the position of the visitor

Look at the visitor

Adjust the body posture to face the visitor

Person detection

Face detection

Face and person localization

Rotate head to centre gaze on the visitor

Rotate torso to face visitor and adjust gaze

UNTIL a visitor is standing in front of the robot

Person distance estimation

The robot engages the visitor

Make a welcome gesture

Say "Hello! Welcome to the Robotics Lab!"

Say "I'm Pepper, your friendly robot tour guide."

Iconic gesture

Speech synthesis

Speech synthesis

Check to see that the visitor is looking at the robot

REPEAT

Look at the visitor

UNTIL the visitor is looking at the robot

Rotate head to centre gaze on the visitor

Detect mutual gaze (*)

Say "Would you like a tour?"

Speech synthesis

IF automatic speech recognition (ASR) enabled

REPEAT

Listen to the visitor and wait for a response

Say "I only understand "Yes" or "No".

Pause for a few seconds.

Speech synthesis

UNTIL the visitor says "Yes" or "No",

OR the robot has prompted three times

Speech event

ELSE

REPEAT

The robot prompts the visitor and waits

Display the words "Yes" and "No" on the robot's tablet PC

Say "Please press "Yes" or "No" on my screen."

Pause for a few seconds.

Display dialogue

Speech synthesis

UNTIL the visitor taps "Yes" or "No",

OR the robot has prompted three times

Tablet PC event

ENDIF

(*) When detecting mutual gaze, the robot only has to determine whether or not the visitor looks at the robot's head, but not necessarily at the robot's eyes. The gaze has to be held for a short period.

The robot decides whether to give the tour or look for another visitor

IF the visitor taps or says “No”, OR does not tap the screen or say anything

Say “Maybe another time”

Speech synthesis

ELSE

The robot starts the tour and visits each exhibit in turn

REPEAT

The robot goes to a tour landmark location

Select a landmark location on the tour

Look up the location on a map

Say “Please follow me”

Navigate to the location

Rotate to face the visitor

Look up knowledge-base

Look up knowledge-base

Speech synthesis

Navigation

Locomotion

Check to see that the visitor is looking at the robot

REPEAT

Look for a face

UNTIL the visitor’s face is detected

Face detection

Determine the location of the visitor

Move head to look at the visitor

Adjust body posture to face the visitor

Face localization

Rotate head to centre gaze on the visitor

Rotate torso to face visitor and adjust gaze

REPEAT

Look at the visitor

UNTIL the visitor is looking at the robot

Face localization

Detect mutual gaze (*)

Point to the featured exhibit (e.g., a lab demo)

Identify the exhibit location

Point to the exhibit

Look at the exhibit

Look at the visitor

Describe the exhibit

Stop pointing

Look up knowledge-base

Deictic gesture

Rotate head to centre gaze on the visitor

Rotate head to centre gaze on the visitor

Speech synthesis

Iconic gesture

UNTIL all landmark locations have been visited

Look up knowledge-base

The robot escorts the visitor back to the entrance

Say “That was the last exhibit on the tour”

Say “I hope you enjoyed your visit”

Say “Let me show you to way out”

The robot looks up the location of the entrance on a Lab map

The robot navigates to the location

The robot rotates to face the visitor

Speech synthesis

Speech synthesis

Speech synthesis

Look up knowledge-base

Navigation

Locomotion

Check to see that the visitor is looking at the robot

REPEAT

Look for a face

UNTIL the visitor’s face is detected

Face detection

Determine the location of the visitor

Move head to look at the visitor

Adjust body posture to face the visitor

Face localization

Rotate head to centre gaze on the visitor

Rotate torso to face visitor and adjust gaze

REPEAT

Look at the visitor

UNTIL the visitor is looking at the robot

Face localization

Detect mutual gaze

Say “Goodbye!”

Wave goodbye

Speech synthesis

Iconic gesture

ENDIF

UNTIL the application is terminated

4. Use-Case Scenario 2: Receptionist

The robot stands at the entrance to the building, actively waiting to engage with a visitor.

In this scenario, we assume the robot approaches the visitor.

Launch the application

REPEAT

REPEAT

The robot makes natural movements

Adjust gaze and sway gently, flexing hands slightly

Animate behaviour

The robot looks for a person close by and listens for a greeting

Try to detect a human body

Try to detect a face

Try to detect a spoken sound

Person detection

Face detection

Sound detection

IF a face, body, or spoken sound is detected

Determine the position of the visitor

Look at the visitor

Adjust the body posture to face the visitor

Face, person, sound localization

Rotate head to centre gaze on the visitor

Rotate torso to face visitor and adjust gaze

ENDIF

UNTIL the visitor in the centre of the robot's field of view

Check to see that the visitor is looking at the robot

REPEAT

Look at the visitor

Face localization

UNTIL the visitor is looking at the robot

Detect mutual gaze (*)

The robot attempts to engage with the visitor.

In a realistic setting it would only do this if it recognized that the person does not work or study in the building.

The robot moves toward the visitor

REPEAT

Rotate to face the visitor

Move towards the visitor

Locomotion

Locomotion

UNTIL the robot is close to the visitor

Person distance estimation

The robot engages the visitor

Make a welcome gesture

Say "Hello, I'm Pepper, your friendly robot receptionist."

Say "I can give you directions to anyone who works here."

Iconic gesture

Speech synthesis

Speech synthesis

Check to see that the visitor is still looking at the robot

REPEAT

Look at the visitor

Face localization

UNTIL the visitor is looking at the robot

Detect mutual gaze (*)

IF automatic speech recognition (ASR) enabled

REPEAT

Listen to the visitor and wait for a response

Say "Please say the name of the person you wish to meet"

Pause for a few seconds.

Speech synthesis

UNTIL the visitor says a name OR the robot has prompted three times

Speech event

ELSE

REPEAT

The robot prompts the visitor and waits

Say "Please type the name of the person you wish to meet"

Display a keyboard on the robot's tablet PC

Pause for a few seconds.

Speech synthesis

Display dialogue

UNTIL the visitor presses enter or the robot has prompted three times

Tablet PC event

ENDIF

(*) When detecting mutual gaze, the robot only has to determine whether or not the visitor looks at the robot's head, but not necessarily at the robot's eyes. The gaze has to be held for a short period.

The robot finds out whether or not the visitor wants assistance

IF the visitor does not type or say a name

Say "Maybe another time. I'll try to assist someone else"

Speech synthesis

ELSE

The robot gives directions

The robot looks up the location of the person on a map

Determine location of worker's office

Look up knowledge-base

Look up the location on a map

Look up knowledge-base

The robot gestures in the direction of the person's office

Say "The person you want to meet is in Room XYZ"

Speech synthesis

Point in the direction of the room

Deictic gesture

Look in the direction of the room

Rotate head toward the office

Look at the visitor

Rotate head to centre gaze on the visitor

Say "It is located in that direction"

Speech synthesis

The robot gestures goodbye

Say "Goodbye!"

Speech synthesis

Wave goodbye

Iconic gesture

ENDIF

UNTIL the application is terminated

Tablet PC event

Principal Contributors

The main authors of this deliverable are as follows (in alphabetical order).

David Vernon, Carnegie Mellon University Africa.

Document History

Version 1.0

First draft.
David Vernon.
7 November 2023.

Version 1.1

Fixed problem with header.
David Vernon.
16 November 2023.