

# The Interactive Museum Guide Robot



15494 Cognitive Robotics

Thomas Chun Fai Lee

Ziyan Xin

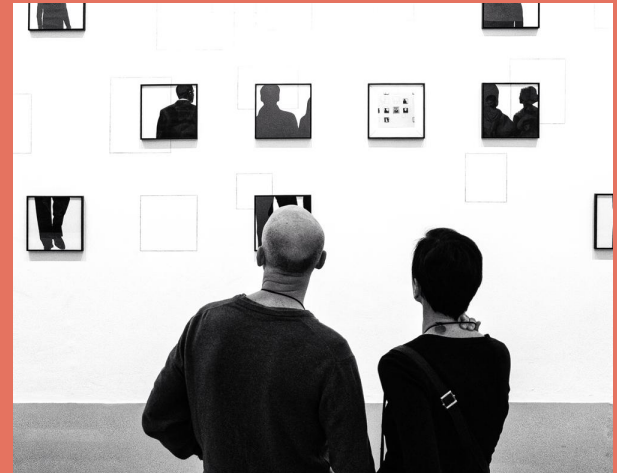


# The Problem

Challenge: How can a small mobile robot autonomously guide visitors through a two-gallery art exhibition and answer questions conversationally?

Constraints:

- Navigate via ArUco markers
- Understand spoken visitor input
- Adjust vision and behavior around state transitions





## Transition

Interpret spatial context to determine the correct doorway command, issuing **#doorpass** to navigate into the Classic or Modern gallery.



## Guided Locomotion

Execute **#pilottoaruco** using a customized FSM with timed delay, offset pose logic, and orientation-aware navigation to position the robot near a target painting.



## Flow Continuation

Based on flow direction and gallery layout, use calculated **#sideways**, **#turn**, and **#forward** commands to reposition for the next painting, repeating analysis.



## Contextual Understanding

Parse natural language input using GPT-4 to determine **gallery preference** and **painting request** (leftmost, all, etc.).



## Dynamic Tour Selection

Provide option between individual or all painting scan logic using current gallery and entry point prompted in GPT. Map user preferences to internal ArUco marker IDs.



## Perceptual Analysis & Tour Narrative

Use **#camera** to capture painting imagery, then GPT-4 generates a **contextualized** museum-style description. Engage the visitor with follow-up dialog prompts.



## Interactive Closure & Scene Transitions

Prompt user for **next action** (another painting, new gallery, or exit). Seamlessly transition using logic and motion control routines with coherent speech output.

# Our Approach – Tour Guide Pipeline

# Interesting Aspect - Variability

## Adaptive Touring Strategy

- Supports both **individual painting selection** and **full-gallery tours**
- Uses GPT prompt logic to interpret user intent and select appropriate mode
- Dynamically chooses **left-to-right** or **right-to-left** flow based on entry context
- Executes a sequence of motions and commentary to simulate a natural tour experience
- Enables a flexible, conversational interface for interactive museum guidance



# RESULTS

## What Worked

**Prompt Engineering:** Designed a robust GPT prompt to interpret visitor input and dynamically select between individual or full-gallery tours.

**Flow Logic Execution:** Successfully implemented various movement sequences based on entry orientation & user desire.

**ArUco Marker Navigation:** Robot reliably piloted to target markers and positioned itself for optimal viewing.

**Interactive Responses:** GPT provided informative painting descriptions and handled follow-up questions naturally.

## What Didn't

**Odometry Drift:** In longer sequences, small odometry errors accumulated, causing misalignment with ArUco markers or incorrect positioning.

**Rigid Full-Gallery Logic:** The robot used hardcoded movement sequences instead of dynamically piloting to each painting's ArUco marker, reducing adaptability to layout changes or marker occlusion, subject to bugs.

# Future Work

**Dynamic Mapping:** Incorporate localization refinement to reduce odometry drift in real-time with Aruco Markers.

**Visual Re-identification:** Enable the robot to recognize previously viewed paintings for personalized revisit options.

**Natural Language Navigation:** Let visitors use casual language (e.g. “take me to the painting with the cat”) instead of fixed options.

**Scalability:** Scale up more rooms with dynamic map building



Demo