Interactive Restaurant Concierge Robot
Elective in AI / HRI Report

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1 Introduction

This report explores Human-Robot Interaction task conducted using the Pepper robot, developed by SoftBank Robotics. Pepper is a family-friendly robot designed to engage and interact with people of all ages. Equipped with sensors, cameras, and audio capabilities, Pepper can be deployed in various settings to facilitate positive interactions.

In this particular task, Pepper was deployed in a restaurant environment with the role of enhancing the overall dining experience of guests of all ages. Pepper provides assistance in a friendly and approachable manner, creating an inviting atmosphere. The human-robot interaction begins from the moment that guest walk inside the restaurant. By combining practical assistance with engaging and interactive features, Pepper aims to make the experience more enjoyable, efficient, and memorable for all guests.

One of Pepper's key contributions is its ability to entertain children, a primal consideration in creating a welcoming family-friendly dining environment. By telling short, engaging stories or offering a selection of interactive games, such as rock-paper-scissors, quizzes, and charades, Pepper helps in keeping the children both occupied and mentally stimulated while waiting for their meals. This feature not only enriches the experience for younger guests but also allows parents to enjoy their meals in a relaxed and uninterrupted manner.

In addition to activities for children, Pepper is equipped to provide engaging interactions for adult guests. It offers real-time information on practical topics such as the local weather forecast and current news, providing a way for guests to pass time and stay informed. These features demonstrate Pepper's versatility in satisfying diverse guest needs, ensuring that both adults and children feel included and valued in the restaurant setting.

Its ability to adapt to the specific needs of diverse guests, whether by providing educational activities for children or engaging adults with practical information, highlights the growing potential of robots in hospitality. Pepper's presence not only enhances the overall experience but also establishes an innovative atmosphere, offering a glimpse into the future of human-robot collaboration in service environments.

In this particular task, Pepper was deployed in a restaurant environment with the primary role of greeting and welcoming guests as they arrive, providing assistance, and interacting in a friendly and approachable manner. To enhance the dining experience, Pepper entertains children by telling stories or offering interactive games to help mitigate waiting times, allowing adults to enjoy their meals in a relaxed atmosphere.

Additionally, Pepper offers interaction opportunities for adults as well, such as providing real-time information on the weather and other relevant topics, further enriching the dining experience.

In particular, the robot is capable of:

- **Detecting the presence of nearby individuals** through audio and video sensors, enabling the robot to initiate interactions, such as inquiring about existing table reservations or assisting guests in making a reservation.
- **Identifying individuals in front of the robot and differentiating among them**, allowing the robot to personalize interactions, tailoring its responses and actions to enhance the user experience.
- **Interacting with adults** by assisting them in choosing the right menu options, providing useful informations such as daily weather forecasts, local and global news of the day.
- **Engaging with children** by telling interactive stories or letting them play games, which helps pass the time and creates a more enjoyable experience for families.

1.1 Context and motivation

As technology advances and reshapes various industries, the hospitality sector has increasingly embraced robotics to take care of customer experiences and improve service quality. This project centers on the deployment of Pepper to serve in a family-oriented restaurant environment. Known for its human-like interactions, Pepper is designed to create warm, memorable experiences by welcoming guests with friendly gestures and personalized greetings.

In this restaurant setting, Pepper plays an important role in enriching the dining experience, particularly for families with children. The robot's interactive features, which include touch, speech recognition, and expressive visual cues, enables it to provide a unique and immersive experience for all guests. It not only greets guests and provides directions to their tables but can also share information about the menu, suggest popular dishes, and even entertain children with interactive and stimulating games or stories while families wait for their orders to arrive.

With these capabilities, Pepper serves as an efficient assistant to restaurant staff, freeing them up to focus on more specialized customer service tasks. By engaging with guests, Pepper creates an inviting atmosphere that can significantly enhance customer satisfaction. This initiative highlights the potential of robotics in hospitality, demonstrating how technology can create more engaging, efficient, and memorable human-robot interactions that meet the evolving expectations of modern customers. Robots can help create inclusive spaces where families feel welcome, providing both practical service and engaging entertainment for children or adults. In addition, robots like Pepper also relieve a consistent part of burden on staff, allowing them to focus on tasks requiring a personal touch, and helping address labor shortages in the industry.

On the economic side, adopting robotic solutions means consistent service quality and the potential to reduce operational costs over time by reducing the human work-load. It also draws in tech-enthusiast customers, creating curiosity and potentially boosting revenue.

In summary, this project explores how robots like Pepper could transform the dining experience by blending human warmth with technological support, offering insights into the future of hospitality both inside and outside of restaurants environments.

1.2 Objectives

The primary objective of this project is to assess and optimize the role of the Pepper robot within a real-world social environment, with a particular focus on its deployment in a restaurant setting. The project aims to evaluate how effectively Pepper can engage guests in a natural and welcoming manner, enhancing their dining experience and supporting the restaurant staff in day-to-day operations. Through this initiative, we seek to understand the robot's capacity to perform a range of essential customer service tasks, from greeting and seating patrons to providing useful information and even entertaining guests while they wait.

Key goals include analyzing Pepper's ability to recognize and respond to guest interactions and whether it can communicate in ways that are intuitive,

personable, and adaptable to various age groups and social dynamics. Pepper's capabilities include greeting patrons as they enter, using its sonar sensors to detect motion and anticipate new arrivals. Upon recognizing guests, Pepper proactively engages with them, offering assistance with table directions based on the guests numbers and preferences, thus alleviating pressure on human staff during busy hours.

Moreover, Pepper is equipped with a suite of supplementary features to enhance the guest experience. For example, it can relay real-time information such as current weather conditions, restaurant menu highlights or the main news of the day. Through its integrated tablet interface, Pepper provides engaging entertainment options, such as interactive games, giving weather forecasts for the day and storytelling sessions, designed to keep children occupied and mitigate the perceived length of waiting times. These elements allow Pepper to cater to the specific needs of family-oriented establishments, fostering a child-friendly environment that promotes repeated visits and positive feedback.

Beyond providing a smooth guest experience, the project also aims to investigate the wider implications of integrating Pepper into customer service roles, highlighting both the benefits and limitations of human-robot collaboration in dynamic, real-world environments. The study will consider factors such as Pepper's ease of use, reliability and adaptability to various service scenarios.

Ultimately, this project seeks to determine the feasibility and scalability of using Pepper and similar robots to complement and enhance customer service roles. By conducting a comprehensive assessment of Pepper's performance, interaction quality, and adaptability, this project aspires to open the way for innovative, technology-driven solutions that can transform customer service in the hospitality industry.

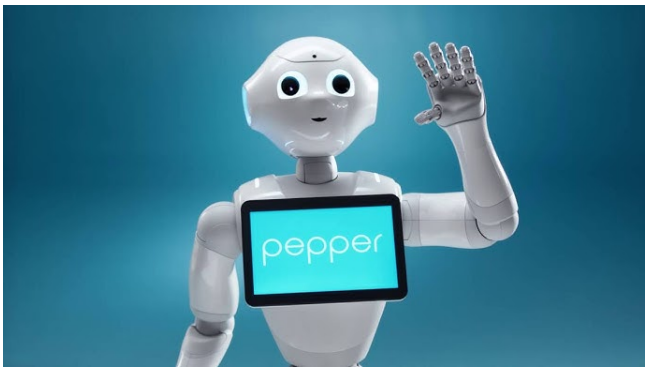

Figure 1: Pepper Robot

1.3 Summary of the results

The project successfully deployed the Pepper robot in a restaurant environment, fulfilling its intended roles and functions. Pepper was effectively programmed to greet and assist guests, enhancing the overall dining experience by creating a welcoming atmosphere for them. The robot's greeting capabilities were smoothly integrated with its motion detection sensors, allowing it to acknowledge new arrivals efficiently. This feature can help streamline the guest experience and reduce the workload on human staff during peak hours.

One of the highlights of the implementation was the successful integration of interactive features aimed at entertaining guests. Pepper's storytelling and game-playing functions will help families enjoy a more relaxed dining experience. Additionally, the tablet interface on Pepper's chest enabled guests to access real-time information on topics such as weather updates, restaurant menu highlights, providing a valuable self-service feature for adults.

Moreover, Pepper demonstrated a solid capability to engage guests of various ages through a combination of verbal and non-verbal communication. The gesture-based game implementation, inspired by popular games, allows for an interactive experience that delights both children and adults alike. These interactions contribute positively to the ambiance of the restaurant, as guests will find Pepper's engagement both entertaining and helpful.

In particular, the following interactive games and storytelling features were implemented to enhance guest engagement:

- **Intelligent Quiz:** Pepper poses a series of stimulating questions to guests, keeping track of scores based on correct or incorrect answers. This quiz adds an educational and entertaining element for players of all ages. The game is composed of 6 questions of various categories, each question answered correctly awards 1 points. If the overall score is greater or equal than 4 the game is considered to be won, otherwise lost.
- **Charades:** Designed for children, this game involves Pepper performing various mimics—such as pretending to be an elephant, a gorilla, or playing sports like football, that children are invited to guess. This active engagement makes waiting times more enjoyable for young guests, transforming a potentially annoying period into a lively and entertaining experience. Additionally, it encourages children to interact with one another, fostering collaboration as they discuss Pepper's mimics and work together to arrive at a collective guess at the end of each round. This not only keeps them engaged but also promotes social interaction and teamwork, adding another layer of value to the activity.
- **Rock-Paper-Scissors:** A classic, easy-to-play game where Pepper competes with guests, keeping track of the score throughout. This playful

activity appeals to both children and adults and adds a fun, competitive aspect to the interaction.

- **Storytelling:** Pepper is equipped to tell engaging and entertaining stories to children, making their waiting time both enjoyable and memorable. This feature is designed to keep young guests occupied while their meals are being prepared, ensuring they remain entertained and content during their visit. To make the storytelling experience even more special, we selected universally recognized and beloved tales, such as *The Three Little Pigs*, *Little Red Riding Hood*, and *Peter Pan*. These stories are familiar to most children and resonate with their imaginations, creating a sense of comfort and delight.

Overall, the project underlines Pepper's potential to enhance the customer service experience in a social environment. Pepper demonstrated reliability and adaptability. The successful implementation of all planned features, including guest greetings, storytelling, interactive games, and real-time information sharing, underscores the robot's capacity to function as a valuable asset in a customer service role.

Through this project, we validated that Pepper can be deployed to complement human staff effectively, improving customer satisfaction and optimizing restaurant operations. This provides a promising foundation for exploring further enhancements and scalability of robotic assistance within similar social environments in the hospitality industry.

2 Related work

In exploring the integration of robotics within the hospitality sector, several studies and projects have laid the groundwork for understanding how robots can enhance customer experiences, in particular we have been inspired by the folloiwng papers.

- **Impact of Service Robots on Customer Satisfaction**: Borghi et al. (2023) [1], in their study titled "The Impact of Service Robots on Customer Satisfaction Online Ratings: The Moderating Effects of Rapport and Contextual Review Factors," highlight the positive influence of service robots on customer satisfaction. Their findings reveal that customers experience increased satisfaction when robots engage meaningfully and develop a connection with them. This aspect is central to our project, which uses the Pepper robot for customer engagement in a restaurant setting.

  In line with the paper's findings, Pepper's ability to engage with guests using conversational and expressive behaviors, creates a more welcoming environment for restaurant guests, particularly families. Furthermore,

while the authors of the paper explore the impact of online review contexts, such as the device used to post a review and the customer's prior experience, our study focuses on in-person engagement metrics. These real-time engagement mechanisms enhance the guest experience by keeping guests, especially children, entertained during waiting times. This approach aligns with the paper's conclusions on how service robots can improve customer satisfaction across various contexts.

- **Robotic in Modern-Day Restaurants and its Impact on the Dining Experience** This paper by Dabral et al. [2], emphasizes that the use of robots in dining establishments is a relatively new concept that has been well received by customers. According to the paper, many reviews highlight that interacting with robots adds an element of novelty and fun to the dining experience, with particular excitement shown by younger guests. The presence of robots enhances the overall ambiance, making the experience memorable and engaging for families and individuals alike.

  While this paper provides a solid foundation by demonstrating the positive reception of robotic systems in restaurants, our project aims to expand on this concept by significantly enhancing the level of human-robot interaction.

  Rather than limiting the robot's role to guiding customers to their tables or taking photos, our approach introduces a deeper and more engaging relationship between the robot and the diners. For instance, our robot will entertain guests during wait times by offering interactive games for children or providing real-time updates on the weather and news for adults. This expanded range of activities will create a more personalized and dynamic interaction, enriching the dining experience further. By combining entertainment, information, and service, our project aspires to redefine the role of robots in hospitality, making them an integral part of a memorable and enjoyable visit.

- **Service Robot Introduction to a Restaurant Enhances both Labor Productivity and Service Quality**

  This study by Shimmura, Takeshi, et al. [3], explores the impact of implementing an automated guided vehicle (AGV) in a Japanese cuisine restaurant. The research highlights how the introduction of the AGV system shifted routine conveyance tasks from human staff to the robot, enabling restaurant managers to optimize staff work schedules and reduce overall labor hours. This transition allowed service staff to focus more on tasks that directly contribute to enhancing the dining experience, such as improving customer interactions. The study demonstrates how automation not only alleviates the workload of staff but also boosts labor productivity and improves service quality by reallocating resources effectively.

Inspired by this work, our project seeks to develop a service robot that similarly reduces the physical and cognitive stress on restaurant staff while fostering a more interactive and engaging environment for diners. By delegating repetitive tasks to the robot, such as guiding customers to their tables or providing entertainment through games and storytelling, restaurant employees can devote more time to creating a personalized and high-quality dining experience. This approach not only addresses the operational efficiency seen in the study but also extends it to enrich the customer's overall visit.

The body of work surrounding human-robot interaction in hospitality underscores the potential for robots like Pepper to transform customer service dynamics. By combining engaging interactions with practical assistance, these robots can create memorable experiences for guests while supporting staff efficiency. Our project builds on these insights, aiming to further validate and expand upon the successful integration of robotics within family-oriented restaurant environments. Existing literature supports our findings regarding Pepper's effectiveness in enhancing guest interactions within a restaurant setting. Future research could explore impacts on customer satisfaction as robotic assistance becomes more prevalent in hospitality contexts.

In conclusion, the integration of interactive robots like Pepper can also provide significant benefits to restaurant staff. By handling tasks such as providing weather updates, delivering news, and offering entertainment, Pepper allows the staff to focus more on their core responsibilities, such as ensuring food quality, attending to customer needs, and maintaining the overall ambiance of the restaurant. This reduction in workload enables the staff to provide a more efficient and personalized service, while also freeing them from repetitive or time-consuming tasks. Furthermore, the unique interaction between the robot and guests can elevate the restaurant's appeal, creating a more memorable dining experience. In this way, Pepper not only supports the operational efficiency of the restaurant but also enhances the work environment for the staff, allowing them to concentrate on higher-value, customer-facing activities, while the robot contributes to an engaging guest experience.

3 Solution

Our project was developed in a Linux environment, chosen for its reliability and flexibility in software development. To streamline the workflow, we used Docker, a containerization platform that allowed us to create isolated environments for both development and testing. Docker's portability also made it easier to share and replicate our setup across different machines, ensuring consistency and reducing the chances of configuration errors.

By utilizing Docker, we established a modular and well-organized workspace. Each container encapsulated the specific dependencies and libraries required for

different parts of the project, preventing conflicts and maintaining a clean environment.

For tasks related to the robot's architecture, we worked with a pre-configured Docker image that included all the necessary tools and libraries for interacting with the robot's software framework. We interacted with the robot's architecture by running commands through docker exec, as shown in the example below:

```
docker exec -it pepperhri tmux
```

The project itself was developed entirely in Python, chosen for its versatility and compatibility with the tools we needed. Python was used to manage the libraries provided by NAOqi, the framework essential for programming and controlling the robot. It also served as a bridge for communicating with an HTML file that managed the tablet interface, allowing us to integrate the robot's physical capabilities with its user-facing features.

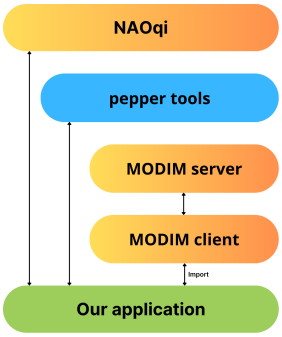

Figure 2: Architect of the software

In our project, we've integrated MODIM, a service designed to simplify human-robot interaction by providing pre-defined functions that are both flexible and easy to use. MODIM serves as a bridge between the developer and the robot, allowing for intuitive customization of interactions without needing extensive low-level programming. There are two main approaches to utilizing MODIM, depending on the level of control and modularity you require:

1. **Direct calls**: This approach provides direct access to MODIM's functionalities through the `im.executeModality(MODALITY, INTERACTION)` command. By specifying the interaction type and the desired action, we can quickly implement specific behaviors, making it suitable for straightforward use cases.

2. **Action-based calls**: For more modular designs, this method uses predefined actions stored in separate files. Using commands like `im.execute(ACTION)`

or `im.ask(ACTION)`, we can use these pre-built actions indirectly. This approach is particularly useful for maintaining a clean and organized codebase. An example is provided in Figure 3.

The strength of MODIM lies in its versatility, offering a variety of interaction modalities that can be used for different application needs:

- **TTS (Text-to-Speech)**: Enables the robot to communicate verbally by synthesizing speech from text input.
- **ASR (Automatic Speech Recognition)**: Allows users to interact with the robot using voice commands, enhancing the naturalness of the interaction.
- **TEXT DEFAULT**: Displays plain text messages on the robot's tablet screen, providing a simple way to convey information visually.
- **TEXT TITLE**: Adds a title to the current display mode, helping to organize content shown on the tablet.
- **BUTTONS**: Generates interactive buttons on the tablet layout, enabling touch-based input from users.
- **IMAGE**: Displays images on the tablet, which can be used for instructional purposes, visual aids, or aesthetic enhancements.

In our project, we chose to use the Action-based method for interacting with MODIM because it keeps the code cleaner and easier to maintain. This approach allows us to manage interactions more systematically by defining actions separately. One of the features of MODIM is its ability to mirror the touch screen interface on a local web page. This functionality provides us with real-time visual feedback of the robot's actions and interactions. The HTML code we developed allows us to customize the layout of Pepper's tablet interface. With this setup, we can design the user experience to meet the specific needs of our application, ensuring both functionality and an appealing appearance.

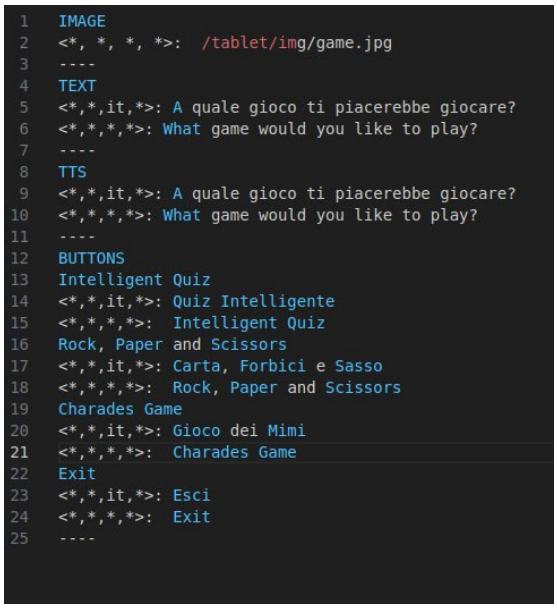

Figure 3: Example of action file

Figure 3 illustrates that within the action files, we have the flexibility to define a user's profile by specifying their spoken language for the interaction. For instance, setting the language code to 'it' switches the interaction to Italian, while '*' represents the default setting, which is English. This capability becomes particularly valuable in scenarios where Pepper is placed in diverse, multicultural environments, allowing it to adapt to user's linguistic preferences.

4 Implementation and results

Here we can analyze the architecture we designed for our Pepper-robot, focussing on the key modules that we have identified

The user interface of the system allows guests to interact with Pepper in several intuitive ways. One of the key features we've implemented is a detection system that uses Pepper's built-in camera sensors to identify when new customers arrive. This sonar-based detection enables the robot to recognize and respond to people in its environment, ensuring it is always ready to engage.

Once a guest is detected, Pepper approaches them and initiates a greeting. The robot's movements and verbal introductions are designed to mirror the kind of welcoming behavior you would expect in a human-to-human interaction. The goal here is to create an experience that feels as natural and comfortable as possible.

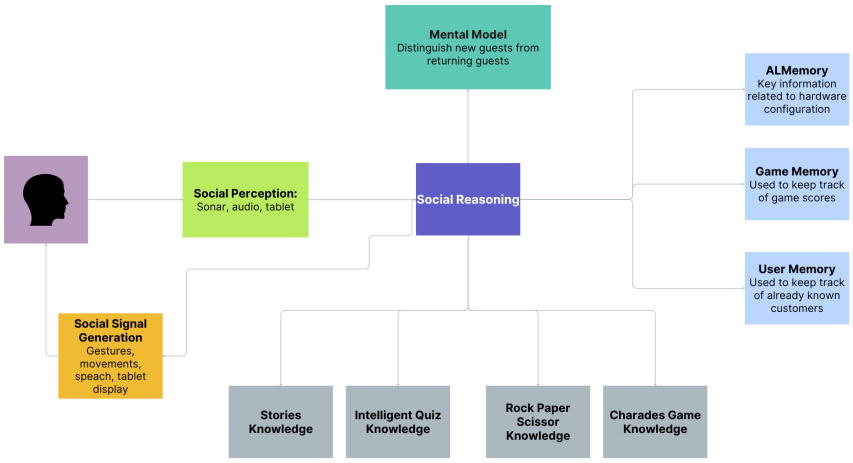

Figure 4: Architecture

The purpose of this design is to make the robot approachable and relatable. Interacting with a robot can sometimes feel awkward or intimidating, especially for people unfamiliar with this kind of technology. By mimicking the dynamics of a typical social interaction, we aim to break down these barriers and make the experience as seamless and enjoyable as possible.

Although Pepper is equipped with a tablet on its chest, the majority of interactions are intentionally designed to be multi-modal, combining both visual and auditory communication. This dual-channel approach utilizes the robot's built-in audio capabilities to complement the textual input and output displayed on the tablet. By providing information in both formats, Pepper accommodates diverse user preferences and enhances accessibility, ensuring a smoother interaction experience for all guests.

When a guest initiates an interaction, Pepper begins by welcoming them and engaging in a dialogue specific to the context of their visit. For example, it may ask questions related to their reservation. At this stage, guests can choose to respond either by using the touchscreen interface on the tablet or through verbal communication with the robot. This flexibility allows users to interact in the way that feels most comfortable to them, whether they prefer the directness of spoken language or the privacy and control of text-based input.

By combining physical gestures, verbal interaction, and digital interface elements, Pepper creates a dynamic and versatile communication system. This multi-modal interaction framework not only improves the efficiency of the interaction but also reinforces Pepper's role as a socially intelligent robot capable

of adapting to different user needs and preferences.

The social reasoning module plays a critical role in interpreting the interaction and determining the most appropriate response based on the guest's preferences. By analyzing input from the guest, whether verbal, or text-based, this module enables Pepper to give its output to align with the specific needs and expectations of the user.

4.1 Mental Model

The Mental Model module plays a central role in Pepper's ability to adapt its interactions based on guest identity. This system relies on a pre-trained classification model, developed using Google's Teachable Machine , to distinguish between children and adults. Additionally, it integrates facial recognition capabilities to determine whether a guest is a new visitor or a returning one. These features enable Pepper to provide personalized interactions, enhancing both the guest experience and the robot's effectiveness in a restaurant setting.

When a new customer approaches, Pepper initiates the interaction with an introduction to the restaurant, offering assistance with table directions or providing information about the menu. For returning guests, the robot greets them personally, with messages like "Welcome back!" or "Great to see you again!" This creates a sense of familiarity and hospitality, similar to the experience provided by a human waiter who recognizes regular patrons.

The classification model is trained with a diverse dataset of images to ensure reliable differentiation between children and adults. This capability allows Pepper to adopt different behavior patterns based on the age of the user.

This dual-level recognition system distinguishing between new and returning guests, adds a layer of personalization that enriches the dining experience making it more memorable.

4.2 ALMemory

The ALMemory module is responsible for managing the hardware components integrated into Pepper, playing a fundamental role in the robot's functionality. Specifically, it governs the motors that control the various parts of Pepper's body, including its arms, head, and torso. By utilizing the ALMemory module, Pepper is able to execute precise, fluid movements that mimic human gestures and actions. These movements allows the robot to engage in natural, social interactions, as they enable Pepper to perform gestures commonly used in human-to-human communication. Through the coordination of these motor functions, ALMemory facilitates the human-like physical expressiveness.

4.3 Game Memory

The Game Memory module for manages the memory resources related to gameplay interactions, such as those involved in intelligent quizzes, rock-paper-scissors, and charades. This module maintains the continuity of the game by tracking key elements such as the points awarded in each round and the overall progression of the game. Through its capabilities, the Game Memory module ensures that the robot can consistently store and retrieve game-related data, allowing it to maintain a coherent and dynamic gameplay experience. Additionally, the module is equipped with decision-making algorithms that determine the winner based on the rules and system of each respective game. This enables Pepper to engage in interactive and competitive play, offering a fun experience for users while ensuring fairness and accuracy in game outcomes.

4.4 User Memory

The User Memory module is designed to store and recognize faces of returning guests who visit the restaurant. Rather than storing personal details, the module focuses on identifying familiar faces, allowing Pepper to recognize customers who have interacted with it in the past. When a returning guest approaches, the robot greets them in a warm and welcoming manner, replicating the behavior of a human waiter who acknowledges a guest's return. This function enhances the guest experience by making the interaction feel more personalized and engaging, as Pepper's recognition of the customer creates a sense of familiarity and hospitality.

4.5 Knowledge Modules

The Knowledge Modules are responsible for storing and managing the information related to the games and stories that Pepper can offer to guests. These modules contain the necessary data to support a variety of interactive activities, such as trivia games, quizzes, and storytelling. By maintaining a database of game rules, question sets, and narrative content, the Knowledge Modules enable Pepper to engage users in a dynamic and interactive manner. This allows the robot to provide a range of entertainment options that are both diverse and in accordance to the interests of the guests.

4.6 Social Signal Generation

The Social Signal Generation module is responsible for managing the various modes of communication that Pepper uses to interact with guests, including gestures, movements, speech, and tablet display options. This module enables the robot to express itself in a socially engaging manner, closely mimicking human communication styles. By coordinating these elements, the Social Signal Generation module ensures that Pepper's interactions are dynamic and responsive, contributing to a more natural and engaging human-robot experience.

5 Results

In this section, we present a detailed example of a complete interaction between a potential user and the robot. This example outlines possible interactions that may occur during the encounter. By walking through the interaction process, our aim is to provide a complete understanding of how the various modules and functionalities of the robot work together.

This demonstration highlights the robot's ability to adapt to user inputs, respond appropriately, and create a dynamic interaction that mirrors real-world social interactions.

5.1 Robot Approach

The first phase of the interaction begins as the customer enters the restaurant. The robot uses its vision sensors to detect the customer and then approaches them. If the robot recognizes the customer as a returning guest, it offers a warm welcome back to the restaurant, giving a sense of familiarity and of personalized service. In alternative, if the customer is new, the robot greets them as a first-time visitor, maintaining an equally welcoming and friendly tone.

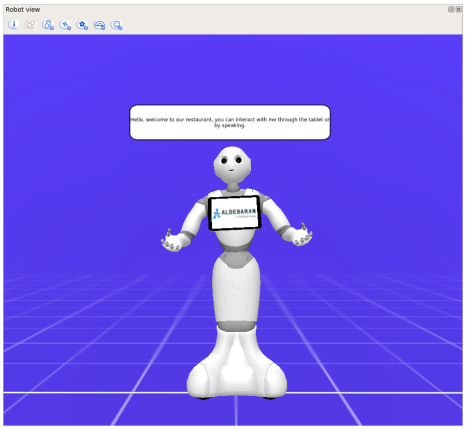

Figure 5: Pepper welcoming guests

Following the greeting, the robot inquires about the size of the party, asking how many guests are present. This information enables the robot to guide the customers to an appropriately assigned table.

Figure 6: Pepper proposing a candlelight dinner

To make the dining experience as personalized as possible, we added a feature designed to fulfill specific guest preferences. If the party consists of two guests, Pepper politely asks whether they would like to dine by candlelight. This feature is intended to create a romantic atmosphere for couples who wish to enjoy an intimate dining experience, adding a thoughtful and unique touch to their meal.

Once guests are seated, Pepper initiates the next phase of interaction by asking about their dietary preferences. The robot offers a selection of menu options which are chosen in order to accommodate various needs, including gluten-free, vegetarian, vegan, and a complete menu. After guests indicate their preference, Pepper displays the corresponding menu on its tablet, allowing guests to browse through the available dishes.

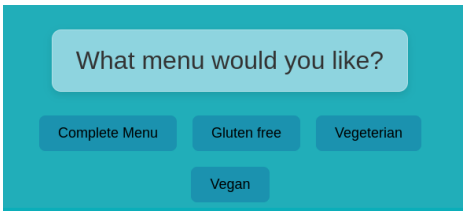

Figure 7: Pepper asking guests what menu they prefer

The ordering process is facilitated through the touch display, where guests can interact directly with the menu to select the items they wish to order. By providing both verbal guidance and a visual interface.

In the next phase, once the order has been sent to the kitchen, Pepper focuses on enhancing the guest's experience by offering activities to mitigate the waiting time while their food is being prepared, ensuring that all guests remain entertained and engaged.

For adults, Pepper provides practical and informative options such as checking the weather forecast for the day or browsing the latest news highlights. These features are designed to adapt to diverse guests interests and keep them occupied in a meaningful way.

Figure 8: Tablet display of the various activities

For children, Pepper offers a variety of interactive games, including rock-paper-scissors, intelligent quizzes, and charades.

5.2 Weather Forecast

The weather forecast activity provides guests with up-to-date information about the local weather conditions. This feature is useful for adults who may be planning their activities after dining. By accessing and delivering accurate weather data, Pepper offers a practical and engaging way to keep guests informed while they wait for their food.

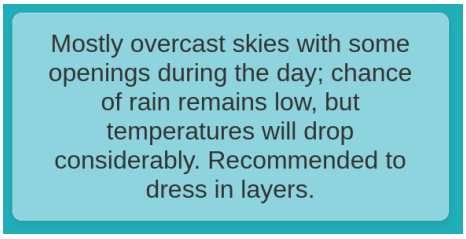

Figure 9: Tablet display of the weather forecast

5.3 News

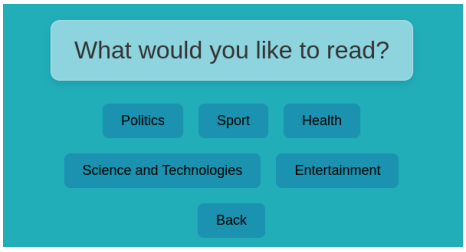

Figure 10: Tablet display of available news sections

The news activity allows Pepper to share information about the major news events of the day. This feature is designed to provide guests with quick and relevant updates on current affairs, making the waiting period more engaging and informative. By offering an overview of the latest headlines, Pepper satisfies guests who enjoy staying informed about the world around them.

Figure 11: Tablet display of health news section

5.4 Games

We have implemented a variety of games designed to keep children engaged and mentally stimulated while waiting for their food to arrive. These activities not only entertain but also provide an opportunity for children to develop critical thinking and problem-solving skills in a fun and interactive way.

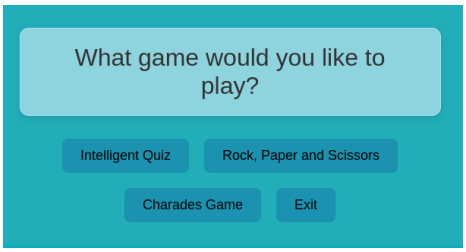

Figure 12: Tablet display of available games

5.5 Rock-Paper-Scissor

Rock-Paper-Scissors is a simple and universally recognized game. Each round, players choose between three options: rock, paper, or scissors. According to the game rules, rock beats scissors, scissors beat paper, and paper beats rock. Points are awarded based on the outcome of each round.

The game is started by Pepper explaining the Rock-Paper-Scissors game rules to those who might now know them.

In this game, Pepper randomly selects its choice—rock, paper, or scissors while the player chooses its pick.

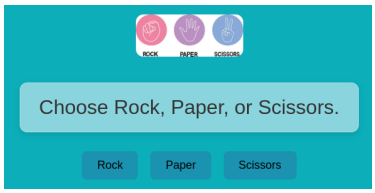

Figure 13: RPS choice.

Figure 14: Pepper's RPS choice.

After both the guest and Pepper have made their selections, the robot compares the results and assigns one point to the winner of the round, while the losing player does not lose any points. The game continues until either Pepper or the guest reaches three points, at which point the robot announces the winner. This simple yet interactive gameplay provides an enjoyable and engaging experience for the young guests.

```
elif game_choice == "Rock, Paper and Scissors":

    play_again = True

    while play_again:

        # Show game rules initially
        im.ask("rps-rules")  # Show rules before
            starting

        player_wins = 0
        pepper_wins = 0
        rounds_to_win = 2

        # Best of three rounds
        while player_wins < rounds_to_win and
            pepper_wins < rounds_to_win:

            player_choice = im.ask("rps-prompt",
                timeout=999)

            # Pepper's random choice
            choices = ["Rock", "Paper", "Scissors"]
            pepper_choice = random.choice(choices)

            # Display Pepper's choice
            if pepper_choice == "Rock":
                im.ask("rps-pepper-rock")
```

```
            elif pepper_choice == "Paper":
                im.ask("rps-pepper-paper")
            elif pepper_choice == "Scissors":
                im.ask("rps-pepper-scissors")

            # Determine round result
            if player_choice == pepper_choice:
                im.ask("rps-result-draw")

            elif (player_choice == "Rock" and
                  pepper_choice == "Scissors") or \
                (player_choice == "Paper" and
                    pepper_choice == "Rock") or \
                (player_choice == "Scissors" and
                    pepper_choice == "Paper"):
                player_wins += 1
                if player_wins == rounds_to_win:
                    im.ask("rps-final-win")  #
                        Player wins best of three
                    break
                im.ask("rps-result-win")  # Player
                    wins round
            else:
                pepper_wins += 1
                if pepper_wins == rounds_to_win:
                    im.ask("rps-final-lose")  #
                        Pepper wins best of three
                    break
                im.ask("rps-result-lose")  # Pepper
                    wins round

        # Ask if the player wants to play again
        play_again_choice = im.ask("rps-play-again")
        if play_again_choice == "Yes":
            play_again = True  # Reset to play again
        else:
            play_again = False  # Exit the loop and
                return to main activity
```

Listing 1: Rock, Paper, Scissors Game Implementation

5.6 Intelligent Quiz

Intelligent Quiz is a game specifically designed for children, which engages them in a mentally stimulating activity while they wait for their food. The game consists of six questions divided into three categories: math problems, word

guessing, and geometric challenges.

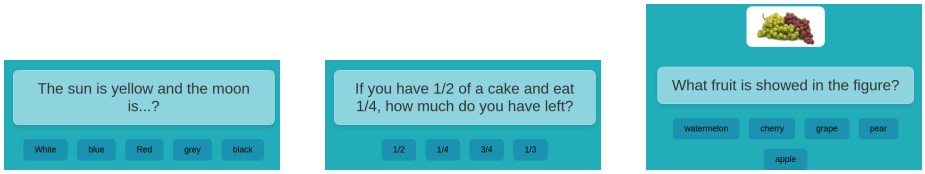

Figure 15: Example of Intelligent Quiz questions

To win the game, participants must answer at least four of the six questions correctly. If fewer than four answers are correct, the game concludes with a loss. This structure encourages children to think critically and apply problem-solving skills in a fun and interactive way.

By incorporating educational elements, the Intelligent Quiz provides a meaningful and enjoyable distraction for kids.

```
elif a == "Game":
    game_choice = im.ask("choose-game")

    if game_choice == "Intelligent Quiz":
        # Original game code remains here
        try_again = True
        while try_again:
            a = im.ask("game-intro")
            if a == "Play":
                points = 0
                a = im.ask("guess-word-1", timeout
                    =999)
                if a == "white":
                    points += 1
                a = im.ask("guess-word-2", timeout
                    =999)
                if a == "leaves":
                    points += 1
                a = im.ask("math-1", timeout=999)
                if a == "1/4":
                    points += 1
                a = im.ask("math-2", timeout=999)
                if a == "1,25 liters":
                    points += 1
                a = im.ask("guess-figure-1", timeout
                    =999)
                if a == "equilateral triangle":
                    points += 1
```

```
                    a = im.ask("guess-figure-2", timeout
                        =999)
                    if a == "grape":
                        points += 1

                    if points >= 4:
                        im.execute("positive")
                        try_again = False
                    else:
                        a = im.ask("negative", timeout
                            =999)
                        if a == "try":
                            try_again = True
                        elif a == "back":
                            try_again = False
```

Listing 2: Intelligent Quiz Game Implementation

5.7 Charades Game

Charades is a well-known game in which one person mimics an action, activity, or animal while the other players try to guess what is being portrayed. In this context, Pepper takes on the role of the performer, leveraging its hardware to mimic various actions through precise movements of its joints.

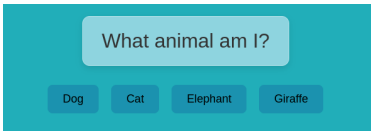

Figure 16: Tablet display of charades game.

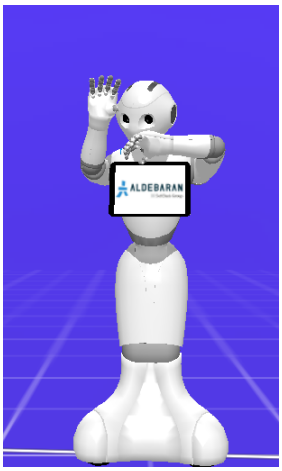

Figure 17: Pepper imitation of an elephant.

Pepper uses this capability to act out behaviors such as imitating an elephant, a gorilla, a person playing football, or someone strumming a guitar.

By using expressive gestures and engaging body language, Pepper brings these actions to life, making the interaction both entertaining and immersive. This activity is designed to keep guests engaged in a lighthearted and enjoyable way.

5.8 Story Time

We have implemented a story module activity in Pepper, designed to entertain guests, particularly children, by telling them popular kids' stories such as The Three Little Pigs, Little Red Riding Hood, and Peter Pan. In this module, we have included short versions of these stories, carefully adapted to be suitable and engaging for young audiences.

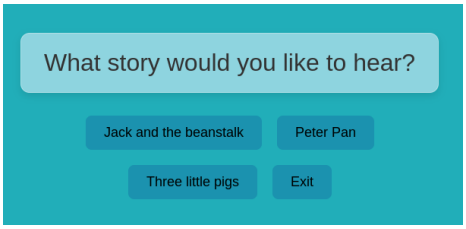

Figure 18: Tablet display of available stories

To ensure a smooth experience, the stories are presented through the tablet interface, allowing children to read the stories at their own pace. We opted not to enable voice functionality for this activity to avoid disturbing other guests who may be enjoying their meal at nearby tables.

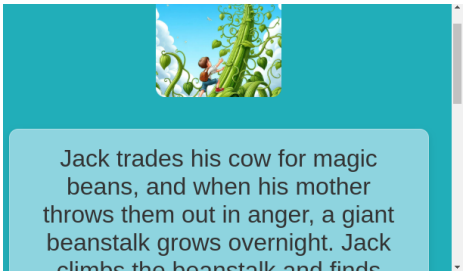

Figure 19: Tablet display of Jack and the beanstalk story

6 Experimental evaluation

We have simulated a variety of interactions that Pepper can perform with guests in a restaurant setting. To achieve this, we utilized the tablet interface together with Choregraphe to coordinate Pepper's movements and gestures. These interactions, designed to reflect real-life scenarios, showcase how Pepper enhances

the dining experience through its capabilities. The results of these simulations, including examples of Pepper's interactions, can be seen in this video created by us to demonstrate the project.

7 Conclusion

Throughout the development of this project, we gained valuable insights and overcame a variety of challenges. One of the primary technical hurdles involved mastering the use of Choregraphe, which required us to adapt to the complexities of programming Pepper's behavior and coordinating its functionalities. Due to the limited availability of the robot itself, we developed a simulated environment that allowed us to refine the robot's movements and gestures while synchronizing these actions with the tablet display. This approach enabled us to test and optimize the system effectively despite hardware constraints.

Additionally, significant thought was given to designing interactions that create a welcoming atmosphere for guests without being intrusive. Balancing the integration of robotic services with the traditional dining experience required careful consideration to ensure that Pepper enhances, rather than disrupts, the ambiance of the restaurant.

While this project demonstrates the potential of robotics in enhancing restaurant experiences, we also reflected on some ethical considerations. Although robotics and automation are advancing rapidly, we believe that the human touch remains an essential component of dining. Human interactions provide a unique, unscripted quality that is difficult for robots to replicate. The presence of human staff contributes to the warmth, individuality, and authenticity of a restaurant, elements that are fundamental to creating a memorable experience. While robots like Pepper can assist in operations and offer entertainment, they should complement human staff rather than replace them, preserving the distinctiveness and personal connection that define a restaurant's character.

This project also highlighted the potential of the field of robotics in transforming service industries. With rapid advancements in robotics technology on the horizon, we anticipate significant improvements in human-robot interaction, making solutions like Pepper increasingly sophisticated and impactful in the years to come. However, the integration of such technologies must always consider the value of human presence in creating truly meaningful experiences.

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