# Personalized Social Interaction with Furhat

---

## Objective:

The primary objective of this research is to explore and enhance the dynamics of personalized social interaction between humans and the Furhat robot. This study focuses on utilizing voice recognition for user identification, allowing Furhat to greet users by name and engage them based on their unique emotional states. By analyzing user responses and detecting emotions, the system tailors its tone and conversational flow, ensuring that the interaction is engaging, empathetic, and relevant. The research also aims to evaluate the effectiveness of a random topic suggestion system in maintaining conversation flow and user interest. By offering topics based on user responses, the system fosters deeper engagement and helps create a natural, emotionally aware conversation. This personalized interaction is expected to improve user satisfaction and contribute to more meaningful human-robot communication.

To further enhance the human-like quality of the interaction, Furhat will mirror and adapt its emotional expressions to match the user's emotional cues. This emotional reciprocity adds depth to the conversation, making it more relatable and genuine. Additionally, the robot will recommend topics based on detected emotional states and user preferences, allowing for a more personalized and intimate experience. The project will assess user engagement through emotional response analysis and conversational success, providing insights into the effectiveness of personalized, emotion-aware social robotics. Ultimately, this research aims to demonstrate how these human-like interactions can improve the quality of human-robot relationships, offering valuable contributions to the field of robotics and human-computer interaction. Through this study, the project seeks to show that personalized, emotionally sensitive interactions can significantly enhance user experiences and satisfaction in human-robot conversations.

## Research Questions and Hypotheses

**Research Question 1:**

How accurately does the voice recognition system identify individual users in real-time, and what impact does accurate identification have on user satisfaction and perceived personalization?

- **Hypothesis 1**: The voice user identification algorithm will achieve an identification accuracy rate of at least 80% when using voice data, accounting for variations in speech patterns and environmental noise.
- **Hypothesis 2**: Higher accuracy in user identification will correlate positively with user satisfaction levels, as it enables a more personalized and contextually relevant interaction experience.

**Research Question 2:**

How does the topic suggestion system influence user engagement, and what role does the avoidance of previously discussed topics play in maintaining user interest over extended conversations?

- **Hypothesis 1**: The topic suggestion feature, designed to avoid previously discussed topics, will lead to longer conversation duration and increased user engagement.
- **Hypothesis 2**: Avoiding repetitive topic suggestions will result in higher user interest and perceived novelty, enhancing overall interaction satisfaction.

## Experiment and Methods

### 1. System Setup and Configuration

**Hardware:**

- Furhat Robot: The primary interaction platform used for user engagement and conversation.
- Microphone and Speakers: Microphone for audio input and speakers for output, both integral for capturing and transmitting voice interactions.

**Software:**

- Furhat SDK: The core framework for programming and managing interactions with the Furhat robot, ensuring seamless user engagement and integration with external APIs.
- Voice model: Used for developing the voice recognition script that processes audio input and identifies users.
- IDE : Intellij for code development and scripting.
- Audio Streaming Libraries: FurhatAudioFeedStreamer for real-time audio streaming and FurhatAudioFeedRecorder for saving audio input for analysis.

**Configuration:**

The system is configured to enable audio streaming via the command `streamer.start` to facilitate real-time interactions and the recording of conversations for post-analysis.

### 2. Experiment Design

**Objectives:**

- Test multi-user interaction and the effectiveness of emotion detection.
- Evaluate the accuracy of voice-based user identification and the ability to greet users by name.

Independent Variables: User speech, emotions, and the discussed topics. Dependent Variables: Furhat's responses, identification accuracy, emotional response correctness, and user engagement.

## 3. Implementation Approach

**Voice Recognition for User Identification:**

- The user's audio is recorded in audioin.vav, which is processed by a voice recognition model. The identified user name is saved to output.txt.
- **Testing**: Furhat reads output.txt to extract the name and greets the user accordingly.

**Emotion Detection and Response:**

- The analyzeEmotion function processes the user's input for emotional keywords (e.g., happy, sad) and triggers corresponding responses and gestures.
- **Testing**: Use emotional phrases to check if Furhat detects emotions and responds accurately.

**Audio Streaming and Recording:**

- The Furhat Audio Feed Demo is used to stream and record both user input and Furhat's output into audioin.vav and audioout.vav files.
- **Testing**: Ensure no loss of audio during streaming, and verify correct storage in .vav files.

**Multi-User Interaction and Topic Engagement:**

- Furhat handles interaction with up to two users, switching between them and engaging them in topic-based conversations.
- **Testing**: Confirm smooth transitions between users and accurate topic responses.

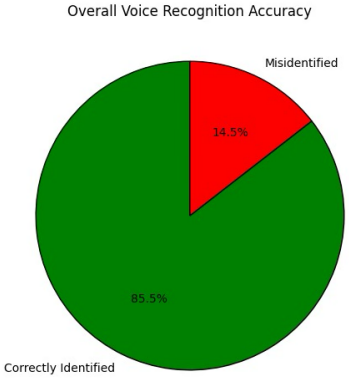
## 4. Data Collection and Analysis

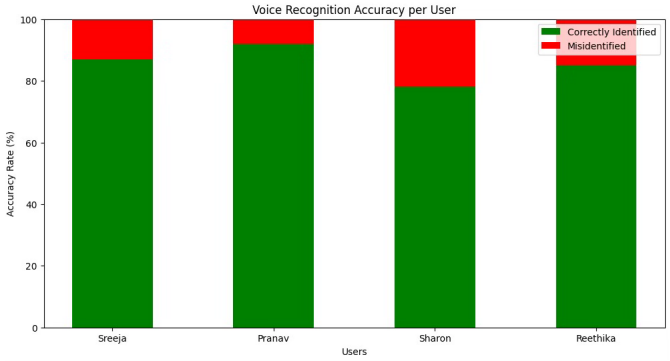
Logs capture the following:

- User identification success.
- Emotion detection accuracy.
- Selected topics and user feedback.
- System errors related to gesture compatibility and topic engagement.

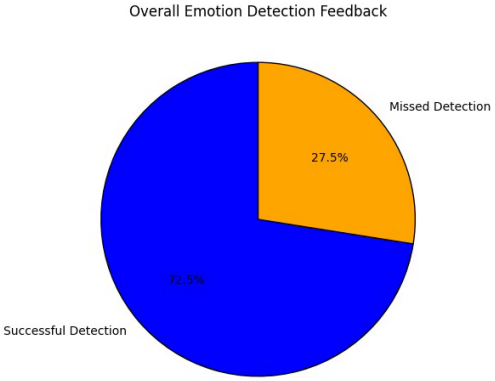
## Metrics Analyzed:

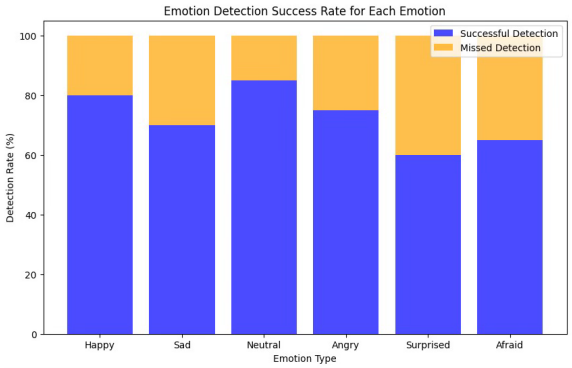
- **Identification Accuracy**: Frequency of correct user identification.



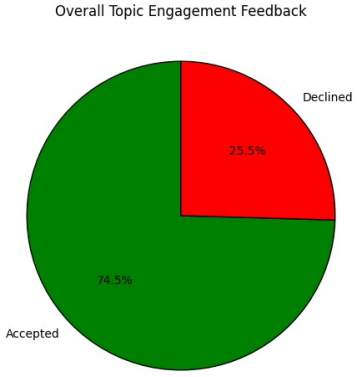



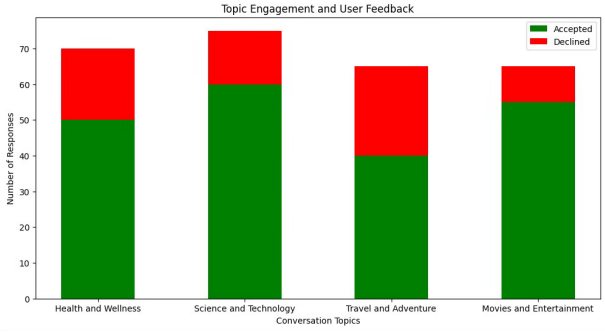

- **Emotional Response Accuracy**: Correctness of Furhat's emotional responses based on user input.




- **User Engagement**: Length and quality of conversations following topic suggestions.



**Results:**

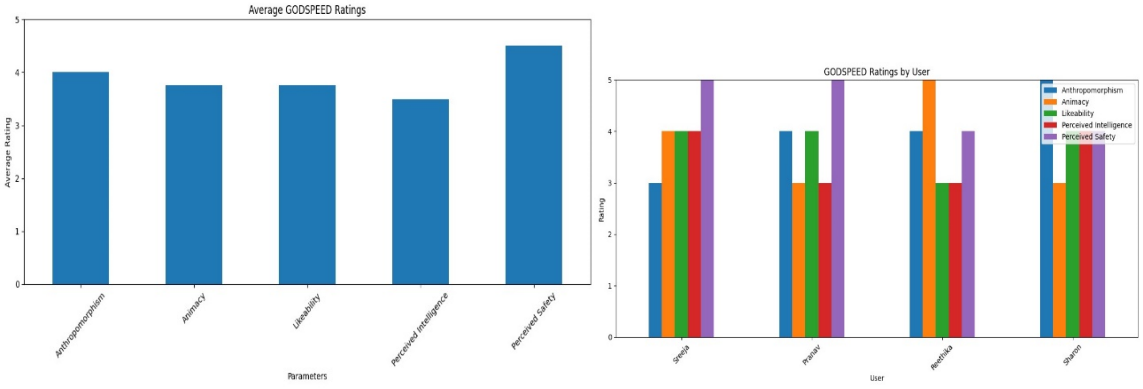
This study evaluated user perceptions of the Furhat robot using the Godspeed and ROSAS scales to measure social, emotional, and anthropomorphic attributes. Four participants interacted with the robot, and their feedback was collected using a 5-point Likert Scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

**1. GODSPEED Scales**

Explanation: The Godspeed questionnaire is a widely used set of scales in HRI to measure user perceptions of a robot's attributes. The scales assess:
Anthropomorphism (how human-like the robot appears),
Animacy (how alive or lifelike it seems),
Likability (how likable the robot is),
Perceived Intelligence (how intelligent the robot seems), and
Perceived Safety (how safe the user feels interacting with the robot).
These scales help quantify users' subjective experience, making it easier to compare different robots or versions of robots during development.

Godspeed Scale

| Attribute | Average Rating |
|---|---|
| Anthropomorphism | 4.0 |
| Animacy | 3.75 |
| Likeability | 3.75 |
| Perceived Intelligence | 3.5 |
| Perceived Safety | 4.5 |

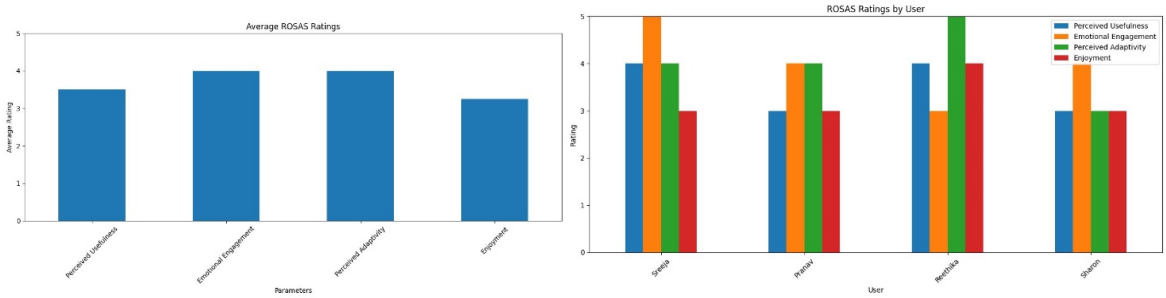


**2. ROSAS Scale**

Explanation: The ROSAS (Robotic Social Attributes Scale) is a tool for measuring how people perceive social aspects of a robot. It focuses on social presence, perceived usefulness, and how interactive and friendly the robot seems. This scale is useful when evaluating robots designed for social tasks, such as customer service or companionship, as it provides insight into how socially engaging the robot is perceived.

ROSAS Scale

| Attribute | Average Rating |
|---|---|
| Perceived Usefulness | 3.5 |
| Emotional Engagement | 4.0 |
| Perceived Adaptivity | 4.0 |
| Enjoyment | 3.25 |




## 5. Design and procedure:

**Modules:**

- **User Identification**: Voice input from audioin.vav is processed to identify the user using a pre-trained recognition model.
- **Emotion Analysis**: The system detects emotions from user input and adjusts Furhat's responses accordingly.
- **Topic Selection**: Furhat randomly selects and suggests topics such as Health, Technology, and Entertainment based on user engagement.

**Procedure**:

- User engages with Furhat, whose input is captured in audioin.vav.
- The voice model identifies the user, and Furhat greets them by name.
- Furhat then suggests topics and responds to user emotions based on detected cues.
- Interaction data is collected and analyzed for accuracy and engagement.

**Conclusion:**

This project successfully integrates voice recognition, emotion detection, and topic-based interaction in the Furhat robot to enhance user engagement through personalized conversations. By using a voice recognition model, the system accurately identifies users based on their voice, allowing Furhat to greet them by name. Emotion analysis further personalizes interactions by adjusting the robot's tone and responses according to the user's emotional state. The random topic suggestion system keeps conversations dynamic and engaging, while data from user sessions revealed valuable insights into the system’s effectiveness in user identification, emotional accuracy, and engagement. Overall, this research demonstrates the potential for creating more natural, personalized, and emotionally aware human-robot interactions.