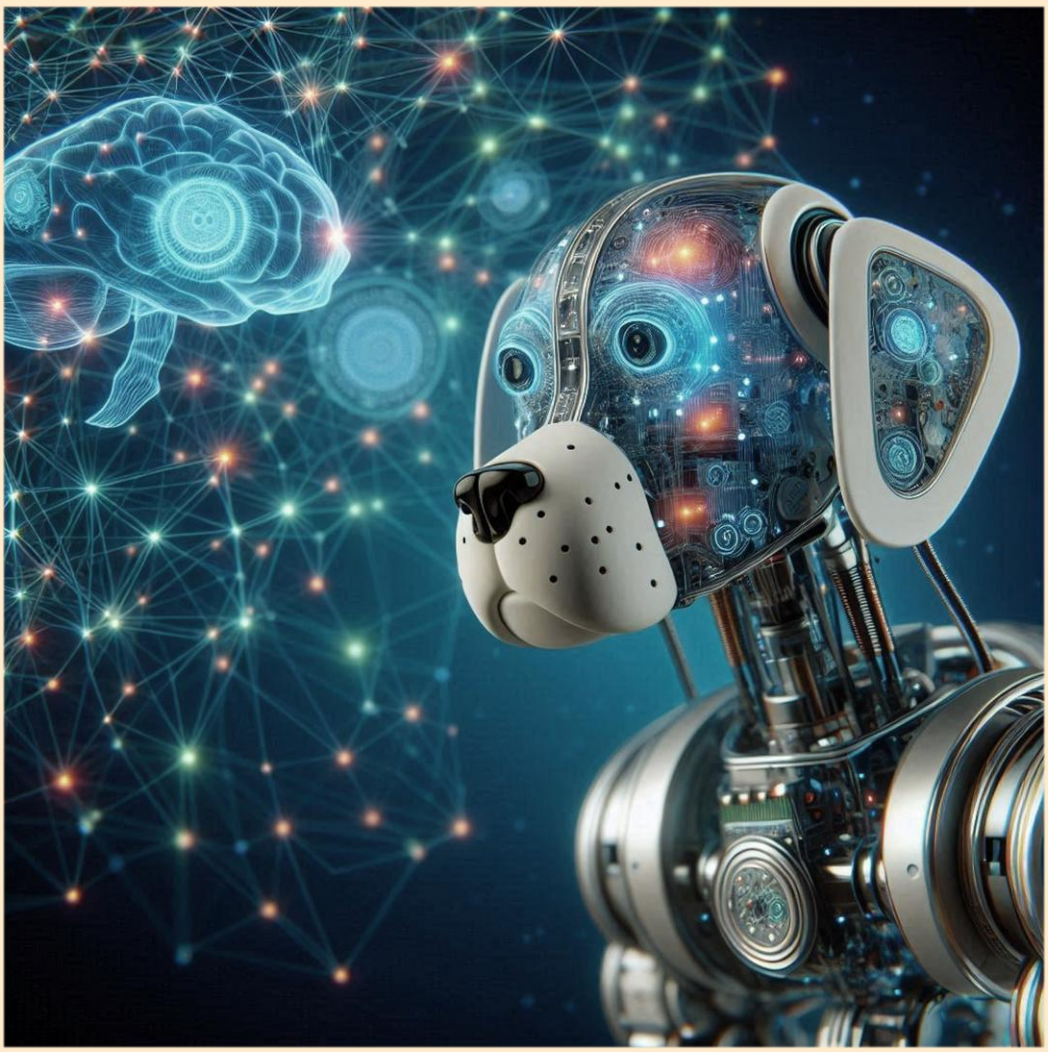

ROBOTIC DOG

Let's Go

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TEAM MEMBERS

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Talking Robot AI Dog is an AI-driven companion that interacts with humans through natural language, recognizes faces and emotions, and adapts its behavior accordingly. Inspired by the idea of a friendly dog that can understand speech, the system aims to:

- Listen to user commands or conversations via microphone.
- Interpret the user's requests using speech recognition (STT).
- Recognize user's identity and emotional state (face recognition + emotion detection).
- Respond with text-to-speech (TTS), making it "talk" like a friendly dog.

1.2 HIGH-LEVEL ARCHITECTURE

→ 1. Microphone Input

→ 2. Speech Recognition

→ 3. Natural Language Processing / AI Logic

→ 4. Decision

→ 5. Response (TTS)

Additionally, camera input is used for face recognition and emotion detection.

2. CORE AI COMPONENTS

2.1 SPEECH RECOGNITION (STT)

- **Goal:**
  - Convert spoken words into text so the AI dog can understand.
- **Implementation:**
  - Google Speech Recognition or OpenAI Whisper for better accuracy, especially in noisy environments.
  - Language Support: English or Arabic (using language="ar-EG").
- **Challenges:**
  - Background noise, different accents, microphone quality.
- **Future Improvements:**
  - Potential wake word detection to reduce false triggers.

2.2 NATURAL LANGUAGE PROCESSING (NLP)

- **Goal:**
  - Interpret user utterances (e.g., “Fetch me a bone!” or “I’m feeling sad.”).
- **Implementation:**
  - Rule-based approach or ChatGPT API for advanced conversation.
- **Use Cases:**
  - Answer user queries, tell jokes, provide comforting words if user is sad.

2.3 TEXT-TO-SPEECH (TTS)

- **Goal:**
  - Give the dog a “voice” to respond verbally.
- **Implementation:**
  - gTTS for a quick online approach (Google TTS).
  - pyttsx3 or Coqui TTS for offline usage.
- **Voice Modifications:**
  - Adjust pitch, speed, or use audio processing (FFmpeg) to produce a dog-like voice.
- **Challenges:**
  - Real-time performance if user expects immediate replies.
  - Natural-sounding intonation for a friendly dog persona.

2.4 FACE RECOGNITION

- **Goal:**
  - Identify if the user is the owner ("Mohammed," for example) or a friend, so the dog can greet them personally.
- **Implementation:**
  - OpenCV for camera input + face_recognition library or a custom CNN (trained on user's face images).
  - CNN approach for classification or Siamese networks for face matching.
- **Benefits:**
  - Personalized greetings, usage-based customization.
- **Data:**
  - Images of the user and friends stored in a dataset.
  - Model trained or fine-tuned to recognize known individuals.

2.5 EMOTION DETECTION

- **Goal:**
  - Understand if the user is happy, sad, angry, etc.
- **Implementation:**
  - CNN trained on a dataset like FER2013 or RAF-DB.
  - Real-time detection from camera frames, leading to empathetic responses.
- **Use Case:**
  - If user is sad, the AI dog tries to cheer them up with a joke.
  - If user is happy, it compliments or encourages them to keep smiling.

3. SYSTEM FLOW

Speech Input:

- User speaks to the dog.

STT:

- Convert speech to text.

Face & Emotion Detection:

- Camera sees the user's face, identifies them, checks mood.

AI Logic:

- **If recognized user:**
  - greet them by name, possibly mention their emotional state.
- **If new user:**
  - ask for their name or remain generic.
- **If user is sad:**
  - respond empathetically.

NLP:

- If using ChatGPT or a custom rule-based system, parse the text for meaning.

Response Generation:

- Compose a text reply.
- TTS module converts it to speech.

Playback:

- The dog "talks" back in a dog-like or friendly voice.

4. IMPLEMENTATION DETAILS

4.1 DATA COLLECTION & TRAINING

- **Face Recognition:**
  - Collect ~30–50 images per person, store in dataset/<person_name>.
  - Train or fine-tune a CNN or use face embeddings.
- **Emotion Detection:**
  - Use a pre-trained model (e.g., from a dataset like FER2013).
  - Real-time inference with a lightweight CNN.
- **Speech Recognition:**
  - Use an online API (Google) or an offline approach (Vosk, Whisper).

4.2 CODE STRUCTURE

- **audio_input.py:**
  - Handles microphone, STT, and TTS.
- **vision_module.py:**
  - Face detection + recognition + emotion detection.
- **ai_logic.py:**
  - Custom conversation logic or ChatGPT integration.
- **main.py:**
  - Brings it all together.

4.3 TOOLS & LIBRARIES

- **OpenCV:**
  - Video capture, face detection (Haar cascades).
- **TensorFlow / Keras:**
  - Building CNNs for face/emotion classification.
- **speech_recognition or Whisper:**
  - STT.
- **gTTS / pyttsx3:**
  - TTS.

5. POTENTIAL CHALLENGES & SOLUTIONS

Noise & Accents:

Solution: Use advanced STT like Whisper or add a wake word to reduce false triggers.

Performance:

Solution: Use GPU acceleration for real-time face/emotion detection.

Accuracy:

Solution: Collect diverse images for face & emotion detection. Fine-tune your CNN with data augmentation.

Multi-language:

Solution: Provide language="ar-EG" for Arabic or en-US for English.

Memory & CPU Usage:

Solution: Use smaller models (MobileNet, distillation) or offload heavy tasks to a server.

6. FUTURE ENHANCEMENTS

Advanced Conversation:

Integrate with ChatGPT or local large language models for more natural dialogue.

Multimodal Emotion Analysis:

Combine facial expressions with voice tone for better emotion detection.

Wake Word Detection:

“Hey Doggo!” to reduce constant listening overhead.

Personality Modules:

Add a playful or calm personality, adjusting TTS style or choice of words.

Larger Datasets:

Expand face & emotion datasets to cover more users and expressions.

7. CONCLUSION

The Talking Robot AI Dog integrates speech recognition, text-to-speech, face recognition, and emotion detection to deliver an interactive, empathetic companion experience.

By leveraging Python libraries (TensorFlow, OpenCV, etc.) and robust models (e.g., Whisper for STT, CNNs for faces and emotions), this project showcases how a single robotic system can blend multimodal AI to provide a fun and supportive environment

→ like having a friendly dog that truly understands and responds to you.

End of Report