A Smart Human Following AI Assistant for Conversation and Mobility

Anusha G B[1], Janani M V[2], Kiran V[3], Meghana Shambhulingayya Hiremath[4], Dr.Prof S G Hiremath[5]

[1]Student, Electronics and Communication, East West Institute of Technology, Bengaluru, India
[2]Student, Electronics and Communication, East West Institute of Technology, Bengaluru, India
[3]Student, Electronics and Communication, East West Institute of Technology, Bengaluru, India
[4]Student, Electronics and Communication, East West Institute of Technology, Bengaluru, India
[5]professor, Electronics and Communication, East West Institute of Technology, Bengaluru, India

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Abstract - This project presents the development of a Smart Human-Following AI Assistant designed to enhance human interaction and mobility support. The system integrates artificial intelligence, computer vision, and robotic mobility to create an autonomous assistant capable of following a designated individual, understanding voice commands, and engaging in natural language conversation. Utilizing sensors such as cameras or ultrasonic modules, the assistant accurately tracks human movement while avoiding obstacles in real-time. The conversational interface is powered by an embedded AI model or cloud-based NLP system, enabling the assistant to understand and respond contextually to spoken commands or queries. This innovation can be applied in environments such as hospitals, airports, shopping malls, or homes, particularly benefiting the elderly and differently- abled individuals. The project demonstrates a step forward in intelligent robotics, combining mobility and communication to offer seamless human-robot interaction.

Keywords: Human-Following Robot, Conversational AI, Mobility Assistance, Embedded AI

1. INTRODUCTION

ANJAN is a next-generation smart human-following AI assistant designed to blend natural communication, autonomous mobility, and intelligent decision-making into one compact robotic companion. Built on the Raspberry Pi 4, it integrates real-time speech recognition, speech synthesis, computer vision, and ultrasonic sensing to enable smooth two- way conversation, accurate human tracking, and safe navigation in dynamic environments. By combining AI, sensor fusion, and embedded systems, ANJAN demonstrates how modern robotics can enhance everyday life—whether as a personal assistant, service robot, or educational platform. Its
modular and scalable architecture supports applications ranging from elderly assistance to indoor navigation, while cloud-based AI and onboard processing enable continuous improvement over time. As a prototype for future assistive robots, ANJAN represents a meaningful step toward personalized, empathetic, and autonomous robotic companions capable of seamlessly integrating into human routines.

2. Body of Paper

SEC 2.1 OBJECTIVES

- To design and implement a voice assistant system using Raspberry Pi

The primary goal is to develop both the hardware and software components required for a functional voice assistant. The Raspberry Pi serves as the core processing unit, managing input from the microphone and output to speakers while executing IoT related tasks.

- To integrate speech recognition and Natural Language Processing (NLP)

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The project aims to use NLP and speech recognition libraries such as Google Speech Recognition or Speech Recognition API to convert spoken words into text and interpret user intent, enabling meaningful and accurate responses.

- To enable voice-based control of IoT devices

The system will connect to IoT-enabled devices, allowing users to perform actions such as turning lights on/off, adjusting appliances, or monitoring sensors through simple voice commands.

- To develop a responsive voice interaction system

The assistant will provide real-time verbal responses using text-to-speech (TTS) technology, enabling smooth, natural, and conversational communication with the user.

To ensure user-friendly operation and cost efficiency The design focuses on creating an affordable, easy- to-use system that can operate independently without reliance on expensive cloud services, making it suitable for smart homes and assistive applications.

SEC 2.2 METHODOLOGY

The methodology for building the Smart Human-Following AI Assistant focuses on bringing together AI, sensor fusion, and embedded systems to create a robot that feels responsive, interactive, and naturally connected to its user. At the heart of the system is the Raspberry Pi 4, which acts as the robot's "brain," handling inputs from the camera, microphone, and ultrasonic sensor while controlling the motors and speaker. To ensure uninterrupted operation, the design includes a stable power setup—where the Raspberry Pi and sensors are powered through a regulated supply, and the motors are driven by a separate battery through a motor driver. The robot gathers real-time data through video for detecting and following a human, audio for understanding voice commands, and ultrasonic sensing for spotting nearby obstacles. Together, these inputs help the robot understand its surroundings and respond more intelligently.

After collecting the data, the Raspberry Pi processes the visual, audio, and distance information using AI algorithms to decide what the robot should do next. The camera input helps it stay focused on its human target, NLP allows it to understand spoken instructions, and the ultrasonic sensor ensures it avoids collisions. Based on these insights, the Raspberry Pi sends commands to the motor driver to control movement, allowing the robot to navigate smoothly and safely. At the same time, the speaker provides clear voice feedback, letting the user know that their commands have been heard or informing them about the robot's status. Through repeated testing and refinement, the system achieves coordinated motion, dependable obstacle avoidance, and natural voice interaction. Overall, this methodology brings together the strengths of embedded AI and real-time processing to create a companion robot that is intelligent, adaptive, and easy to communicate with.

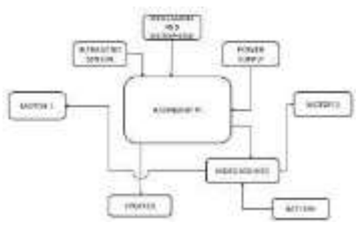

Fig 1. Block Diagram of A Smart Human Following AI Assistant for Conversation and Mobility

SEC 2.3 IMPLEMENTATION

The flowchart illustrates how the intelligent human-tracking robot operates by showing the smooth coordination between its vision, voice, and sensing modules. The process starts as soon as the robot is powered on—its microcontroller initializes, and all essential components like the camera, ultrasonic sensors, and voice recognition systems are activated. After confirming that each sensor is functioning properly, the robot begins searching for a human target using live video captured from the camera. Once a person is detected, it shifts to processing voice commands so the user can interact with it naturally through speech. This allows the robot to follow instructions and respond in a more human-like and intuitive way.

At the same time, the robot continuously scans its surroundings with ultrasonic sensors to detect obstacles and avoid collisions. Using the combined information from human detection, voice input, and obstacle sensing, the system decides how the robot should move—adjusting its speed, direction, and distance to safely follow the user. Throughout the process, the text-to-speech module provides clear voice feedback to keep the interaction smooth and responsive. This loop of detection, decision-making, and communication continues until the robot receives a stop command or loses sight of the human target, at which point it safely shuts down. The flowchart captures this entire cycle, showing how multiple modules work together to create a reliable, interactive, and intelligent tracking experience.

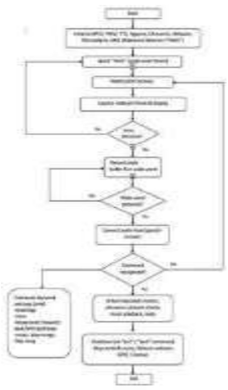

Fig 2. Flow Chart of Proposed work SEC 2.4 RESULTS

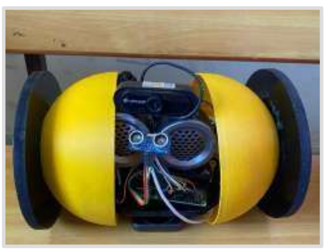

Fig 3 Working Model

Fig 4 Connections

Fig 5 Monitoring

Fig 6 Obstacle Detection with Live Camera

3. CONCLUSIONS

The developed system brings together human detection, voice command recognition, and autonomous navigation into a single, intelligent robotic platform that feels interactive, responsive, and practical for everyday use. By integrating the Raspberry Pi with OpenCV, ultrasonic sensors, and speech- based controls, the robot can detect a person, follow their movements, understand spoken instructions, and respond with clear audio feedback—all in real time. This makes the interaction more natural and user-friendly while showcasing how a compact, low-cost embedded setup can deliver reliable tracking, monitoring, and obstacle avoidance. The project also highlights the effective use of IoT principles, allowing real- time data processing, remote monitoring, and flexible control. With its blend of automation, AI-driven decision-making, and scalable design, the system provides a strong foundation for future enhancements such as improved accuracy, expanded command sets, advanced machine learning features, and greater connectivity. Overall, it demonstrates a well-rounded and modern approach to robotics and smart assistance, offering a practical and adaptable solution suitable for real- world applications and future innovation.

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REFERENCES

[1] Rajakumar P., K. Suresh, Boobalan M., and Archana R., “IoT Based Voice Assistant using Raspberry Pi and Natural Language Processing,” *IEEE*, 2024.

[2] Ghaidaa Hadi Salih Elias, “Review of Hardware Implementation for the Two-Wheeled Self-Balancing Robot,” *IEEE*, 2024.

[3] Tommaso Nesti, Santhosh Boddana, and Burhaneddin Yaman, “Ultra-Sonic Sensor Based Object Detection for Autonomous Vehicles,” 2023.

[4] H. Zhou, C. Xu, X. Tang, S. Wang, and Z. Zhang, “An Examination of Vision-Laser-Based Civil Infrastructure Monitoring and Inspection,” *IEEE*, 2022.

[5] Cherng Liin Yong, Danny Wee-Kiat Ng, and Ban Hoe Kwan, “Human Monitoring and Tracking with OpenCV and Raspberry Pi,” *IEEE*, 2022.