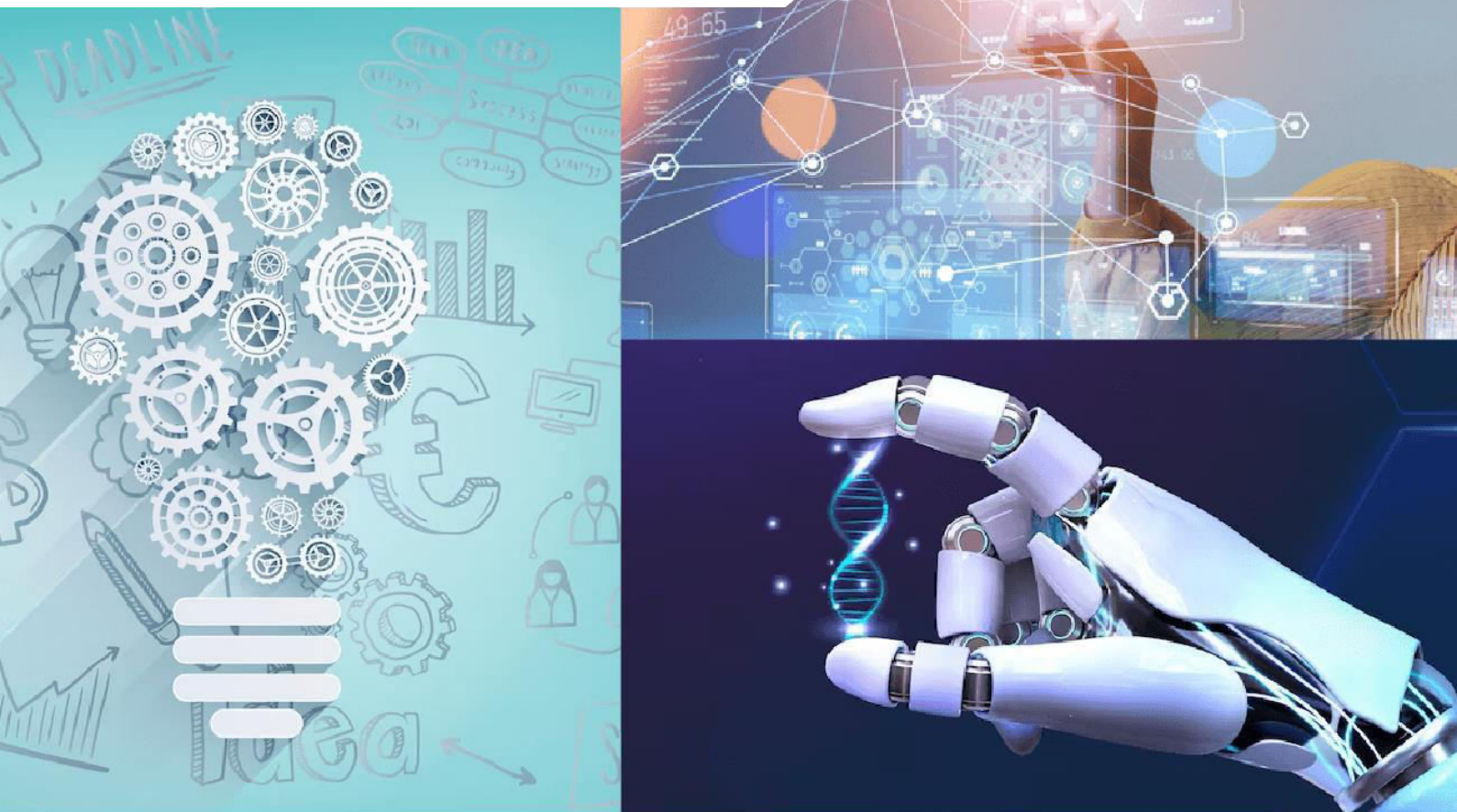




International Journal of Advanced Research in Education and Technology (IJARETY)

Volume 12, Issue 1, January-February 2025

Impact Factor: 7.394



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



Semi-Humanoid Robot

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ABSTRACT: This paper presents the design, development, and implementation of a semi-humanoid robot tailored to enhance modern living through advanced automation, mobility, security, and artificial intelligence. The robot features voice-controlled home automation, enabling effortless operation of household devices and systems using natural language commands. Its mobility system allows smooth navigation in dynamic environments, ensuring it can autonomously perform tasks and respond to user instructions efficiently.

The robot is equipped with a comprehensive suite of security sensors for real-time monitoring of intrusions, environmental anomalies, and other safety-critical events, providing timely alerts to ensure a secure home environment. The integration of AI further enhances its capabilities, enabling intelligent decision-making, adaptive learning based on user behavior, and proactive assistance in daily tasks.

This project emphasizes the synergy between hardware and software components, including sensor networks, motorized mobility, and AI algorithms, to create an innovative solution for smart living. The proposed system demonstrates the potential of semi-humanoid robots as versatile, interactive, and intelligent companions, offering significant contributions to the fields of robotics, automation, and smart home technology.

KEYWORDS: Voice-Controlled Home Automation, Mobility in Robotics, Security Sensors, Artificial Intelligence (AI) Integration

I. INTRODUCTION

The development of semi-humanoid robots represents a significant advancement in modern robotics, with applications spanning automation, security, and intelligent assistance. This project focuses on designing a multifunctional semi-humanoid robot capable of enhancing convenience, safety, and interaction in smart living environments. The robot integrates multiple modules, each designed to address a specific aspect of its functionality. Below is an overview of the key modules:

1.Voice-Controlled Home Automation Module:- This module empowers the robot to act as an interface between users and their home appliances. Utilizing speech recognition and natural language processing (NLP), the robot can interpret voice commands to perform actions such as controlling lights, fans, and other devices. The goal is to simplify daily tasks by enabling intuitive, hands-free operation.

2.Mobility Module:-To navigate and perform tasks within its environment, the robot is equipped with mobility features. This module incorporates motorized wheels, obstacle detection sensors, and algorithms. The robot can move efficiently in various home layouts, avoiding obstacles.

3.Security and Monitoring Module:- Ensuring home safety is a critical feature of this project. The security module integrates sensors such as IR (infrared), motion detectors, and environmental sensors to detect, and respond to emergencies. Alerts are generated in real-time to keep the user informed.

4.Integrated AI Module:- Artificial intelligence lies at the core of the robot's advanced functionalities. This module enables the robot to enhance AI the robot's ability to provide personalized assistance, and anticipate user needs, making it a truly interactive and intuitive companion.

II. PROBLEM STATEMENT

Design a semi-humanoid robot capable of performing some tasks in industrial settings, such as assembly line work or handling toxic materials, to improve worker safety and productivity. It can protect home or office from fire and A semi-humanoid robot equipped with advanced sensors like gas detection and smoke detection and mobility capabilities which help to protect users house or office Semi-humanoid robot that can assist elderly individuals with daily activities, including mobility support and emergency response, to enhance their quality of life.” Design a semi-humanoid robot to serve as an interactive talking feature which can help to learn new things and can also perform some task

III. OBJECTIVE OF PROJECT

Develop an Intuitive Voice-Controlled Home Automation System:

The project seeks to create a voice-controlled interface that allows users to manage various devices and systems within their home environment. This includes controlling lighting, fans, appliances, and other connected devices. The system will leverage speech recognition and natural language processing (NLP) technologies to interpret and execute user commands accurately. The aim is to make smart home technology accessible and convenient for all users, including individuals with mobility challenges or limited technical expertise.

Mobility Capabilities for Movement:

Mobility is a key feature that differentiates this semi-humanoid robot from stationary automation systems. The objective is to equip the robot with a mobility module, including motorized wheels, sensors for obstacle detection. This will enable the robot to move efficiently within various home layouts, handle dynamic environments, and perform tasks such as responding to user commands.

Integrate a Security Module:

Ensuring home safety is a core component of this project. The security module will include a suite of sensors such as IR (Infrared) sensor, smoke sensor, and flame sensor for detecting intrusions, monitoring air quality, and identifying potential hazards like gas leaks or fires. The system will be designed to generate real-time alerts and notifications, ensuring users are informed about any anomalies or security threats. This integration aims to provide a proactive approach to home security and immediate response capabilities.

Implement Artificial Intelligence for Personalization and Adaptability:

Artificial intelligence is central to the robot's ability to provide an intelligent and interactive user experience. The AI module will answer the user's questions. It will facilitate context-aware responses, proactive assistance . This feature will transform the robot into a truly personalized companion capable of enhancing daily living through smart, adaptive interactions.

IV. FUTURE SCOPE

1. **Healthcare:** Assistance for elderly, health monitoring, telemedicine support.
2. **Dynamic Mobility:** Future versions could allow the robot to move up stairs, adjust its posture, or even perform simple household tasks like picking up objects or delivering items within the home
3. **Real-Time Alerts & Communication:** Integration with home security systems for real-time alerts through voice or mobile apps, and the robot could even provide updates to emergency responders in case of a breach.
4. **Disaster Response:** Future iterations might be designed to assist in case of disasters like fire or earthquakes, providing critical information or helping users evacuate.
5. **AI Safety & Privacy:** With integrated AI and voice control, ensuring that data privacy and ethical AI use are in place will be critical. Future development should include strong encryption, secure data storage and privacy protection mechanism.
6. **Voice Authentication:** Enhancing security through voice biometrics to ensure that only authorized users can access sensitive information or control automation features.

V. EXISTING SYSTEM

Voice-Controlled Home Automation Systems (Amazon Echo (Alexa), Google Home):

Voice-controlled home automation systems allow users to control smart devices such as lights, thermostats, locks, and other appliances through voice commands. These systems use Natural Language Processing (NLP) to interpret spoken commands and execute tasks like adjusting the temperature, turning lights on or off, or playing music. Popular systems like Amazon Echo, Google Home, and Apple HomeKit integrate with a wide range of smart home devices and operate through cloud-based platforms.

Autonomous Mobile Robots (AMRs)(Roomba (robotic vacuum cleaner)):

Autonomous mobile robots (AMRs) are robots designed to move independently and perform specific tasks within an environment. For instance, Roomba is a robotic vacuum that uses sensors like LiDAR and infrared to detect obstacles and map the home to clean floors autonomously. Similarly, Pepper is a humanoid robot designed to interact with people, offering entertainment and basic service tasks. These robots typically use advanced sensors for navigation, ensuring they avoid obstacles and can adapt to changing environments.

Security and Monitoring Systems(Ring Security Cameras, ADT Security Systems):

Security systems like Ring provide video surveillance, motion detection, and real-time alerts through cloud integration. These systems can detect motion or unusual activity and alert homeowners via smartphone apps, while also recording video footage for later review. Nest Protect is another example, which is designed to monitor smoke and carbon monoxide levels, providing voice alerts in case of any dangers. ADT is a well-established company in home security, offering professional monitoring, sensors, and cameras.

AI-Powered Personal Assistants and Robots(Sophia (Humanoid Robot by Hanson Robotics)):

AI-powered robots like Jibo and Anki Vector utilize artificial intelligence to engage with users, recognize faces, interpret speech, and provide personalized interactions. Jibo was designed to be a social robot capable of conversing with people, remembering user preferences, and adapting to the user's personality. Similarly, Vector is a small robot that uses AI to understand and respond to voice commands, recognize people, and perform basic tasks like taking pictures or answering questions.

Sophia, developed by Hanson Robotics, is one of the most advanced humanoid robots, with highly expressive facial features and the ability to hold conversations using AI. Sophia can recognize faces, process emotions, and engage in real-time interactions.

VI. LIMITATION

Complexity of Integration:

Integrating multiple subsystems, such as voice control, mobility, AI, and security, into a single robot can be technically challenging. Ensuring that each module (home automation, mobility, security, AI) communicates seamlessly and functions in real-time requires sophisticated software and hardware integration, which can lead to delays, errors, and increased development costs.

Battery Life and Power Management:

Power consumption is a major concern for semi-humanoid robots, especially if they include mobility features (such as motors or wheels) and sensors. Ensuring the robot can perform its tasks continuously without draining its battery too quickly will require efficient power management and possibly larger batteries, which may increase size and weight.

Mobility and Navigation Constraints:

Despite advancements in robot mobility, navigating complex environments like homes with narrow hallways, stairs, or uneven floors remains challenging. The robot's ability to maneuver effectively, avoid obstacles, and detect potential hazards without getting stuck or damaged requires precision in both hardware (sensors, actuators) and algorithms. Mobility limitations might also affect the robot's ability to perform tasks in different rooms or levels of a house.

Dependence on Automation:

Over-reliance on the robot for daily tasks, security, and monitoring could lead to users losing important life skills or becoming too dependent on technology. Balancing automation with human involvement and ensuring the robot doesn't replace essential human interactions is an important ethical consideration.

High Development and Production Costs:

Developing a semi-humanoid robot with integrated mobility, home automation, security, and AI features can be costly. The cost of hardware components (motors, sensors, cameras, processing units) and software development (AI, system integration) might make it difficult for the robot to be affordable for widespread use, particularly in household markets where budget constraints exist.

Data Privacy and Security Risks:

Since the robot is designed to interact with and gather data from various IoT devices (e.g., security cameras, home appliances), ensuring the privacy and security of user data is critical. If not properly protected, the system could be vulnerable to hacking, leading to unauthorized access or manipulation of personal data, home security systems, or even the robot's functions.

VII. IMPLEMENTATION

Voice-Controlled Home Automation System:- This module empowers the robot to act as an interface between users and their home appliances. Utilizing speech recognition and natural language processing (NLP), the robot can interpret voice commands to perform actions such as controlling lights, fans, and other devices. The goal is to simplify daily tasks by enabling intuitive, hands-free operation.

Mobility System:- To navigate and perform tasks within its environment, the robot is equipped with mobility features. This module incorporates motorized wheels, obstacle detection sensors, etc. The robot can move efficiently in various home layouts, avoiding obstacles and reaching designated locations.

Security and Monitoring System:- Ensuring home safety is a critical feature of this project. The security module integrates sensors such as IR (infrared), flame sensor, and smoke sensors to detect intrusions, monitor ambient conditions, and respond to emergencies. Alerts are generated in real-time to keep the user informed.

Integrated AI System:- Artificial intelligence lies at the core of the robot's advanced functionalities. This module enables the robot to respond to user's input. AI enhances the robot's ability to provide personalized assistance, anticipate user needs, making it a truly interactive and intuitive companion.

VIII. CIRCUIT OF THE SEMI-HUMANOID ROBOT PROJECT USING ARDUINO:

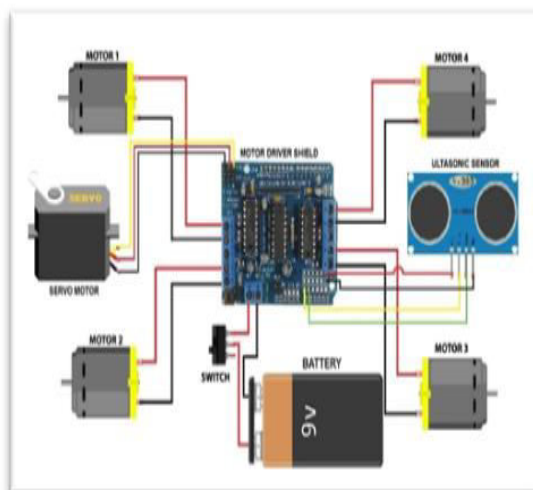


Fig.1 Voice Control Mobility Sensors

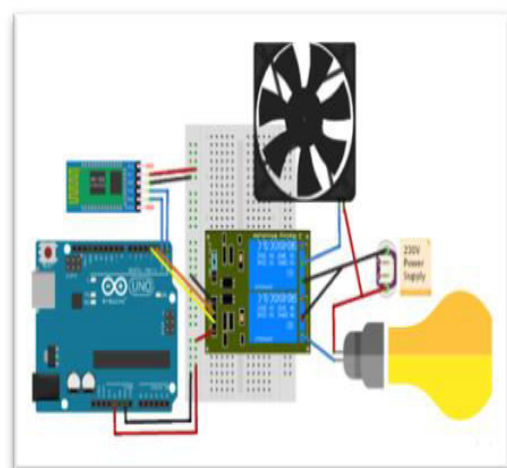


Fig.2 Voice Control Home Automation

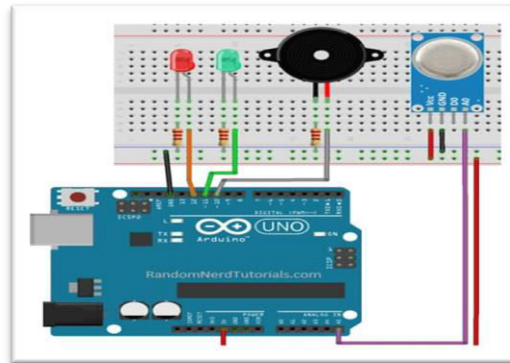


Fig.3 Home Security Sensors

IX. CONCLUSION

In conclusion the development of the semi-humanoid robot has successfully demonstrated the potential of combining voice-controlled home automation, mobility, home security features and AI integration. Through the use of sensors, the robot is able to monitor and secure the home environment while providing efficient automation of various tasks. The voice control system enhances user interaction, making it more initiative and accessible. Mobility features enable the robot to navigate and perform tasks autonomously, offering convenience and assistance to users. The integration of AI allows the robot to adapt to user preferences and enhance its functionality over time. This project illustrates the growing potential for humanoid robots to play a significant role in smart home ecosystems, improving both efficiency and safety for users.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude and appreciation to the experts who have contributed to the development of semi-humanoid robot. We would also like to extend our heartfelt thanks to our project guide R.C.Dhandekar and HOD P.D.Kate for their constant support, guidance, valuable suggestions, and modifications to enhance the quality of our project work. Their insights and encouragement have been instrumental in the success of our project. We would also like to thank the faculty members of our department for their valuable feedback and support throughout the project.

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International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975

Impact Factor: 7.394