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AN AUTONOMOUS COLLEGE INFORMATION ROBOT

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Abstract – College Introduction Robot is an innovative project that combines robotics, communications technology, and visual interaction. This Paper Presents the design and development of College Introduction Robot, a semi autonomous interactive system created to improve visitor engagement within educational institutions. Conventional campus guidance methods such as brochures, notice boards, and staff-led tours often suffer from limited availability, inconsistence explanations, and low interactivity. To address these challenges, the proposed robot delivers reliable campus information through voice-based communication, expressive visual feedback, and guided mobility. This system integrates Raspberry Pi 4 for high level processing and Arduino Mega for real time hardware control. Ultrasonic sensors support obstacle detection and safe navigation, while DC gear motors and motor drivers enable movement across campus environments. Voice recognition and question-answering functions allow the robot to respond naturally to visitor queries related to departments, facilities, admissions, and academic programs. OLED eye animations, TFT display messages, and handshake interaction using servo motors further enhance user engagement by creating a friendly and human-like communication experience. As a result, the system not only improves institutional presentation but also modernizes campus outreach by offering prospective students, parents, and academic visitors an engaging introduction to the college environment. An intelligent socially interactive campus robot enhances visitors engagement through autonomous guidance, responsive communication, and smart institutional assistance

Index Terms – Arduino Mega, Embedded Systems, Human-Robot Interaction, Interactive Robotics, Raspberry Pi Voice Based Communication

I. INTRODUCTION

Rapid progress in robotics, artificial intelligence, and embedded systems is reshaping how interact with machines in everyday environments. Intelligent technology that once belonged mainly to research laboratories are now widely applied in customer service, healthcare, smart homes, and public assistance systems. Educational institutions are also embracing these Innovations to improve accessibility, modernize communication, and create stronger engagement visitors. Within this evolving technological landscape, the College Introduction Robot emerges as a practical and innovative solution for transforming how colleges welcome, guide, and inform prospective students, parents, and academic guests.

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Campus visits strongly influence how visitors perceive an institution's academic culture, infrastructure, and technological readiness. First impressions often shape important decisions related to admissions and institutional preference. Traditionally, colleges rely on brochures, notice boards, sign displays, guided tours, or staff-led explanations to share campus information. The proposed College Introduction Robot addresses these challenges by providing a semi-autonomous, interactive, and consistently available campus assistance platform.

The system is designed to communicate naturally with users while delivering accurate information about academic departments, admission procedures, campus facilities, laboratories, faculty achievements, and student services. By reducing dependency on manual guidance, the robot helps institutions maintain reliable visitor support throughout the day.

By combining intelligent automation with human- centered interaction, the college introduction Robot transforms campus visits into engaging, informative, and memorable experiences while showcasing the institutions commitment to innovation.

LITERATURE REVIEW

Banerjee, Mr Sujan, et al. Recent advancements in robotics, artificial intelligence, and human-computer interaction have significantly influenced the development of interactive robotic systems. Researchers have increasingly focused on making robots more intuitive, communicative, and socially acceptable in real world environments. Despite these advancements, most existing Systems either focus on voice based interaction or visual interfaces independently. Limited research has been explored the seamless integration of speech communication, visual display, and IoT connectivity within a single robotic platform. This gap highlights the need for a unified system that combines these features to create a more natural, efficient, and user, friendly human robot interaction experience [1]. M. Vignesh Kumar et al. have presented a system for humans to interact with machines. Voice controlled robotic systems represent a significant step in this direction, allowing users to communicate with robots using simple spoken commands instead of complex manual controls. The system uses Bluetooth communication to connect with mobile devices, enabling real-time command transmission and execution. While this approach improves usability and accessibility and it is mainly limited to predefined commands, lacks advanced interaction features. Additionally, the absence of visual feedback restricts user engagement and understanding of the robot's responses [2]. Dinh, Long Q., et al. has provided a detailed review of security challenges in Mobile Robotic Assistant systems used across healthcare, industry, and public services. It also evaluates various security solutions such as cryptographic methods, intrusion detection systems, blockchain, and AI based approaches based on efficiency and practicability. Important security requirements like data confidentiality, validation, and system reliability are discussed alongside practical constraints [3]. Chen, Xieling, et al. The review highlights how robots support AI collaborative, mobile, and distance learning while enhancing student engagement, motivation, and higher order thinking skills. However, it also identifies significant challenges, including limited real-world implementation, technological constraints, and low instructor acceptance. A key contribution of the study is its focus on Human Centered AI, advocating for systems that consider learners need real world contexts [4]. Prasad, Vignesh, et al. highlights the importance of touch-based interactions in making robots appear more natural and socially acceptable across domains such as healthcare, education, and service industries. The process of organizing and classifying existing research is based on design, control, and behavioral aspects of robotic handshakes. Overall, the paper offers valuable insights and future directions for developing more adaptive, human-like, and socially intelligent robotic interaction systems [5]. Nguyen, Thanh-Hiep, et al. The paper builds upon earlier research in virtual assistants, telepresence systems, and service robots, highlighting their growing importance in educational settings. Prior works have demonstrated that chatbot-based virtual assistants can efficiently handle frequently asked questions using techniques such as Artificial Intelligence Markup Language (AIML) and Latent Semantic Analysis, thereby improving student support systems. The reviewed work contributes to this domain by presenting a holistic and practical implementation of multiple robotic assistants, showcasing their potential to transform traditional campuses into intelligent, adaptive, and student-centric environments [6]. John, Linda, Nilesh Vishwakarma et al. presents a cost-effective robotic assistant designed to support elderly and physically challenged individuals. It integrates voice recognition, object detection, and image processing using Raspberry Pi and OpenCV. The system enables users to control robot movements, access information, and perform simple tasks through speech commands. By combining AI-based perception and assistive functionalities, the study highlights the potential of personal robots in improving independence, reducing manual effort, and enhancing quality of life in daily environments [7]. Budiharto, Widodo et al. explores the development of an intelligent humanoid robot capable of answering user queries using deep learning techniques. Previous research in question answering systems has applied methods such as cosine similarity, CNNs, and RNNs, showing that deep learning models generally outperform traditional approaches. Notably, RNN-based architectures are found to be more effective in handling sequential language data compared to CNNs in natural language processing tasks. Other works have also utilized generative models and knowledge-based systems, combining structured data with neural networks to improve answer accuracy. Additionally, approaches leveraging large-scale datasets like Wikipedia and have enhanced model training and evaluation [8]. Oltean, Stelian-Emilian et al. focuses on the design and development of a low-cost autonomous mobile robot platform using Arduino Uno and Raspberry Pi for navigation tasks. Earlier studies in mobile robotics highlight the growing importance of embedded systems and microcomputers in enabling affordable and flexible robotic solutions. In addition, prior research has addressed key challenges such as mapping, localization, path planning, and obstacle avoidance using sensors like ultrasonic, infrared, and cameras. The reviewed paper builds upon these contributions by integrating both hardware and software components into a unified system capable of line following, environment mapping, and object handling [9]. Sali, Sharana Basappa, et al. demonstrated a voice-controlled multipurpose robot using an Android smartphone interfaced with an Arduino board via Bluetooth communication. The system employed the open-source Pocket Sphinx library for offline speech recognition, enabling hands-free navigation commands such as forward, backward, left, and right. A key design consideration was the use of an activation phrase to prevent unintended robot movement from background noise. The study highlighted false-positive recognition as a primary limitation and recommended using 2–3 Word commands to balance usability and accuracy.

The hardware architecture incorporated a PIC16F877A microcontroller, DC motors, and LED directional indicators, offering a low- cost, energy-efficient solution applicable in military, hazardous environment, and assistive technology domains [10].

METHODOLOGY

Developing College Introduction Robot involves a multidisciplinary approach, integrating advancements in artificial intelligence, robotics, and human computer interaction. The methodology can be outlined in the following key phases:

1. Sensor Data Acquisition and Preprocessing:

The robot continuously gathers distance information form ultrasonic sensors and filters out noise, ensuring accurate and stable readings for reliable environment understanding and safe operation.

2. Obstacle Detection and Navigation Decision:

Using processed sensor data, the robot detects obstacles and intelligently decides movement actions such as navigating freely, stopping for interaction, or adjusting direction to avoid collisions.

3. Voice Input Capture:

When a user approaches, the robot activities its microphone to capture voice commands, allowing natural and hands-free communication without requiring any physical interaction or external device.

5. Speech Processing:

The captured voice is converted into text and analyzed using natural language processing to understand the user’s intention, enabling the robot to respond appropriately to different types of queries.

5. Response Retrieval:

Based on the identified intent, the robot searches its internal database and selects the most relevant and accurate response, ensuring consistent and reliable information delivery to every user

6. Audio Response Generation:

The selected response is converted into speech using a text-to-speech system, allowing the robot to communicate answers clearly and effectively in a natural and understandable voice.

7. Visual Feedback and Expression:

To enhance interaction, the robot displays expressive animations on an OLED screen, reflecting different states like attention, thinking, and engagement, making communication more interactive and human-like.

OBJECTIVES

1. Interactive Voice-Based Communication:

To equip the robot with a natural language processing driven question-and-answer system that allows visitors to inquire about academic programs, campus facilities and admission procedures, receiving consistent and accurate spoken responses in real time.

2. Human-Friendly Physical Interaction:

To implement a servo-controlled handshake mechanism that enables the robot to greet visitors in a physically engaging and socially comfortable manner, synchronized with its voice output and visual expressions for a cohesive interaction experience.

3. Expressive Visual Feedback:

incorporate OLED-based animated eye displays that convey emotional states such as attentiveness, engagement and processing, thereby making the robot appear more approachable and reducing the perceived mechanical nature of human-robot interaction.

4. Reliable and Maintainable System Design:

To construct the robot using modular 3D-printed components and a robust Battery Management System, ensuring ease of part replacement, structural durability and stable performance across varied operating conditions.

5. Scalability and Future Readiness:

To architect both the software and hardware layers in a modular fashion, allowing straightforward integration of future enhancements such as face recognition, multi-language support, cloud connectivity and additional sensor modules without requiring fundamental redesign.

II. PROBLEM STATEMENT

Educational institutions welcome thousands of prospective students, parents and visitors every year, yet most campuses still rely on conventional guidance methods that fall short in several critical areas.

1. Inconsistent Information Delivery:

Different staff members tend to explain the same campus information in varying ways, leading to an uneven visitor experience where important details about academic programs, facilities or admission procedures are sometimes skipped or communicated unclearly. Such inconsistency can create confusion and leave visitors with an incomplete or inaccurate understanding of what the institution truly has to offer.

2. Limited Staff Availability and Resource Inefficiency:

During high-footfall periods such as admission seasons or open-day events, the number of visitors often exceeds the available staff capacity, leaving many people unattended and unguided. On quieter days, assigning dedicated personnel solely for visitor guidance results in poor utilization of human resources, making it difficult for institutions to maintain a consistently high standard of assistance throughout the year.

3. Lack of Engagement Through Static Displays:

Conventional notice boards and information panels are fixed in nature and cannot respond to individual visitor queries or adapt to specific informational needs. For younger visitors especially, such displays feel outdated and fail to generate curiosity, offer personalization or leave any meaningful and lasting impression.

4. Absence of a Technology-Driven First Impression:

In an era where digital transformation is reshaping every sector, relying solely on manual guidance sends an unintentional signal that the institution may not be keeping pace with modern advancements. Visitors increasingly expect smart and interactive experiences, and without a technology-integrated welcome system, colleges miss a significant opportunity to reinforce their identity as innovation-driven institutions.

III. SOLUTION OF THE PROBLEM

The College Introduction Robot is proposed as a smart, interactive and always-available alternative that directly addresses each of the limitations identified above. By combining embedded systems, voice-based communication and expressive physical interaction, the robot offers a reliable and engaging visitor experience that no traditional method can consistently replicate.

1. Consistent and Accurate Information Delivery:

The robot is programmed with a structured knowledge base covering all essential institutional information, ensuring that every visitor receives the same accurate and complete explanation regardless of the time of day or volume of footfall.

2. Interactive and Engaging Visitor Experience:

Rather than presenting information through lifeless boards or printed materials, the robot engages visitors through natural voice conversations, expressive OLED eye animations and a friendly servo-controlled handshake mechanism.

3. Showcasing Institutional Commitment to Innovation:

Deploying a technologically advanced robot as the face of campus welcome sends a powerful message to every visitor about the institution's forward-thinking culture and readiness to embrace modern solutions.

IV. BLOCK DIAGRAM

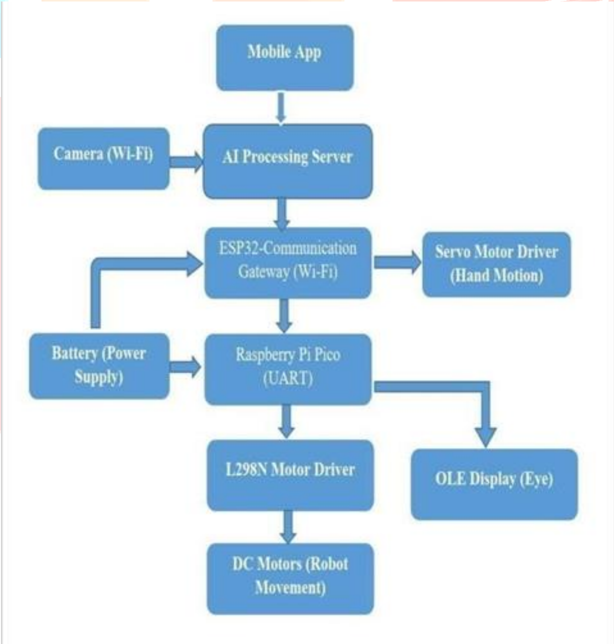

Figure 1: Block Diagram of Collage Introduction Robot

The block diagram of the College Introduction Robot represents how all the major components of the system are connected and how they communicate with each other to make the robot function as a complete unit.

At the top level, the Mobile App allows an operator to send commands and monitor the robot wirelessly over Wi-Fi, acting as the human control interface for the entire system. The Camera (Wi-Fi) captures live visuals from the robot's surroundings and sends that data wirelessly to the AI Processing Server, which acts as the central intelligence of the system. This server handles all the complex tasks such as processing voice inputs, generating chatbot responses, performing face recognition and deciding what action the robot should take next. Once the server makes a decision, it sends the corresponding instructions to the ESP32, which works as a wireless communication gateway. The ESP32 receives these commands over Wi-Fi and forwards them to the Raspberry Pi Pico through UART communication. It also directly controls the Servo Motor Driver, which drives the servo motors responsible for the robot's hand movement and handshake gesture. The Raspberry Pi Pico handles all low-level hardware operations. It processes the instructions received from the ESP32 and controls both the L298N Motor Driver and the OLED Display. The L298N Motor Driver amplifies the control signals and powers the DC Motors, which are responsible for the robot's physical movement across the campus.

The OLED Display mounted on the robot's face renders animated eye expressions, giving the robot a friendly and expressive appearance during interactions. Finally, the Battery supplies power to the entire system, keeping all components operational throughout the robot's working hours.

V. SYSTEM DESIGN

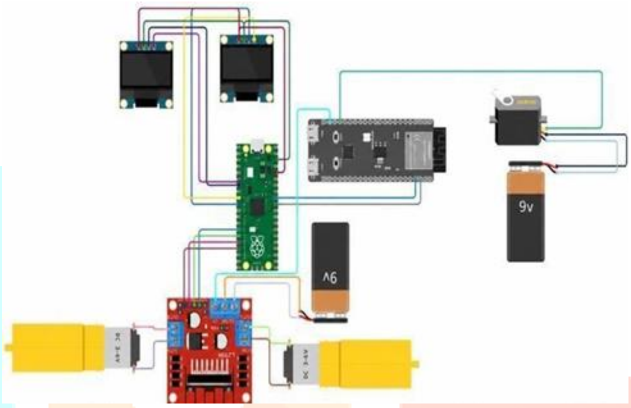

Figure 2: Circuit Design

The College Introduction Robot integrates a mobile app, AI processing server, ESP32, Raspberry Pi Pico, camera, motors and OLED display into a unified architecture, where each component communicates seamlessly to deliver autonomous movement, intelligent conversation and expressive human-like interaction.

VI. MODEL SPECIFICATION

1.Wi-fi Camera:

Figure 3: Wi-fi Camera

Captures live visuals from the surroundings and streams the footage wirelessly to the AI server for real-time face detection.

2.ESP32 Wi-Fi Module:

Figure 4: ESP32 Wi-Fi Module

Acts as a wireless communication bridge, receiving commands from the AI server and forwarding them to the Raspberry Pi Pico.

3.Raspberry Pi Pico:

Figure 5: Raspberry Pi Pico

Serves as the low-level hardware controller, translating received instructions into precise control signals for motors and display

4.L298N Motor Driver:

Figure 6: L298N Motor Driver

Amplifies control signals from the Pico and delivers sufficient current to drive the DC motors in required directions.

5.DC Gear Motors with Encoders:

Figure 7: DC Gear Motors with Encoders

Drive the robot's wheels for movement and use encoders to provide accurate feedback on speed and distance travelled.

6.Servo Motor MG996

Figure 8: Servo Motor MG996

Powers the robot's arm mechanism, enabling smooth and controlled handshake gestures when greeting visitors during interaction.

7. Lithium Battery (Power Supply):

Figure 9: Lithium Battery

Supplies rechargeable electrical power to all active components, keeping the entire robot system operational throughout working hours.

1. Buck Converter:

Figure 10: Buck Converter

Regulates and steps down the battery voltage to stable levels suitable for safely powering sensitive electronic components.

2. OLED LCD Display:

Figure 11: OLED LCD Display

Renders animated eye expressions on the robot's face, giving it a friendly and emotionally expressive appearance during interactions.

3. Wheels:

Figure 12: Wheels

Attached to the DC gear motors, wheels enable the robot to move smoothly and navigate freely across campus surfaces.

4. 3D Printed Chassis and Body Parts:

Figure 13: 3D Printed Chassis and Body Part

Form the structural frame and outer body of the robot, providing a lightweight, customizable and durable physical structure.

5. Ball Caster Wheels:

Figure 14: Ball Caster Wheels

Provide additional balancing support at the base of the robot, ensuring smooth and stable movement across flat surfaces.

HARDWARE & SOFTWARE REQUIREMENTS

1. Hardware Requirements:

- Wi-Fi Camera
- ESP32 Wi-Fi Module
- Raspberry Pi Pico
- L298N Motor Driver
- DC Gear Motors with Encoders
- Servo Motor Mg996
- Lithium Battery (Power supply)
- Buck Converter
- OLED LCD Display

- Wheels
- Battery Holder
- 3D Printed Chassis and Body Parts
- Ball Caster Wheels

2. Software Requirements:

- Mobile app
- AI processing server

VII. ADVANTAGES

1. Consistent Information Delivery:

Unlike human guides, the robot delivers the same accurate and complete information to every visitor without any variation or omission.

2. Round-the-Clock Availability:

The robot operates continuously throughout the day without depending on staff schedules, ensuring no visitor ever goes unattended or unguided.

3.Engaging Visitor Experience:

Combining voice responses, handshake gestures and animated eye expressions creates a truly memorable and enjoyable interaction that static displays simply cannot offer.

4.Reduced Operational Burden:

By handling visitor guidance autonomously, the robot frees up college staff to focus on more specialized and productive responsibilities elsewhere.

5.Cost Effective Over Time:
Although initial setup involves investment, the robot significantly reduces long-term costs associated with hiring and managing dedicated visitor guidance personnel
.
6.Technology Showcase for the Institution:

Deploying a smart interactive robot at the entrance reflects the college's forward-thinking approach and commitment toward embracing modern innovative technologies.

7.Human-Like Interaction:

The handshake mechanism and expressive OLED eyes make the robot feel approachable and friendly, encouraging visitors to interact comfortably and confidently.

8.Modular and Upgradeable Design:

The 3D printed body and modular software architecture make it straightforward to replace damaged parts or add new features anytime.

9.Low Power Consumption:

Powered by a lithium battery with a buck converter, the robot consumes energy efficiently and operates for extended hours on single charge.

10.Scalable for Multiple Environments:

Beyond college campuses, the same robot design can be adapted for hospitals, hotels, museums and various other public service environments.

VIII. RESULTS & DISCUSSIONS

The College Introduction Robot was successfully built and tested to verify that all integrated components functioned.
The robot moved forward, backward and turned in required directions without any instability or mechanical interruptions. The ball caster wheels provided adequate balance support, and the overall movement across flat indoor surfaces remained consistent and controlled at all times.
The voice-based interaction system produced satisfying results during testing. The robot was able to listen to visitor queries, process the intent behind each question and deliver clear spoken responses within an acceptable response time. The conversation flow felt natural enough to keep visitors engaged without experiencing any noticeable delays between question and answer.
The handshake mechanism performed exactly as intended. The MG996 servo motor produced smooth and well controlled arm movement that resembled a natural human greeting gesture. Visitors who interacted with the robot during testing responded positively and found the handshake feature to be both friendly and memorable, which validated the importance of physical interaction in human robot engagement.
The OLED eye animations added a significant layer of personality to the robot. The display rendered smooth transitions between idle, attentive and processing states, making the robot appear more expressive and emotionally relatable to the people interacting with it. The power supply system delivered stable performance throughout the testing sessions. The robot operated continuously for approximately five hours on a single charge, confirming that the battery and buck converter combination provides sufficient and reliable power for real world deployment.
Overall, the College Introduction Robot successfully demonstrated that combining voice interaction, physical gesture, expressive display and autonomous movement into a single affordable system can create a genuinely engaging and consistent visitor experience suitable for educational institutions.

IX. CONCLUSION

The College Introduction Robot represents a meaningful step forward in how educational institutions can reimagine their approach to visitor engagement and campus guidance. What began as an effort to address the everyday limitations of manual guidance methods evolved into a fully functional, interactive and autonomous robotic system that brings together multiple technologies under a single cohesive platform. Throughout the course of this work, it became evident that the real challenge was not just building a robot that could move or speak, but creating one that could genuinely connect with people. Achieving that required careful thought about every layer of interaction, from the way the robot greets a visitor with a handshake, to the way its eyes animate during a conversation, to the clarity and accuracy of the spoken responses it delivers. Each of these elements was designed not for technical novelty alone, but because they collectively shape how a visitor feels during the interaction.
Looking ahead, there remains considerable room for growth. Integrating multi- language support would allow the robot to communicate with a far wider and more diverse range of visitors. Adding facial recognition capabilities would enable personalized greetings and tailored responses based on returning visitors. Connecting the system to cloud-based platforms would allow real-time updates to the knowledge base without requiring any manual reprogramming. Each of these enhancements would bring the robot closer to functioning as a truly intelligent and adaptive campus companion. In conclusion, the College Introduction Robot successfully full fills its purpose of delivering consistent, engaging and technology-driven visitor guidance. It stands as a practical demonstration of how thoughtfully integrated systems can solve real institutional challenges while simultaneously leaving a lasting and positive impression on every person who interacts with it.

X. FUTURE SCOPE

Multi-language support can be added to allow the robot to communicate with visitors speaking different regional languages, making it more inclusive and accessible to a wider audience. Facial recognition technology can be integrated to enable the robot to identify returning visitors and deliver personalized greetings and responses based on their previous interactions. In the longer term, the same core architecture can be adapted and deployed beyond college campuses into environments such as hospitals, hotels and government offices, proving that the system holds strong potential for broader real-world applications.

REFERENCES

1.Banerjee, Mr Sujan, et al. "AI-POWERED TALKING ROBOT WITH VISUAL DISPLAY." InternationalJournal of Communication 1.2 (2025).
2.Zhang, Ying, et al. "Environment modeling for service robots from a task execution perspective." IEEE/CAA Journal of Automatica Sinica 12.10 (2025).
3.Van Scoy, Bryan, Peter Jamieson, and Veena Chidurala. "On First-Principle Robot Building in Undergraduate Robotics Education in the Robotic System Levels Model." Robotics 14.6 (2025).
4.Chen, Xieling, et al. "Artificial intelligent robots for precision education." Educational Technology & Society 26.1 (2023).
5.Prasad, Vignesh, Ruth Stock-Homburg, and Jan Peters. "Human-robot handshaking: A review." International Journal of Social Robotics 14.1 (2022).
6.Nguyen, Mui D., and Thuong TK Nguyen. "Solutions to Improve Indoor Positioning Accuracy supporting Autonomous Mobile Robots." Journal of Future Artificial Intelligence and Technologies 2.1 (2025).
7.Cabibihan, John-John, et al. "Guidelines for robot-to- human handshake from the movement nuances in human-to-human handshake." Frontiers in Robotics and AI 9 (2022).
8.Budiharto, Widodo, Vincent Andreas, and Alexander Agung Santoso Gunawan. "Deep learning-based question answering system for intelligent humanoid robot." Journal of Big Data 7.1 (2020).
9.Oltean, Stelian-Emilian. "Mobile robot platform with arduino uno and raspberry pi for autonomous navigation." Procedia Manufacturing 32 (2019).
10.Sali, Sharanabasappa, et al. "Voice activated multipurpose robot." Int. J. Adv. Eng. Technol. Manage. Appl. Sci 3 (2016).