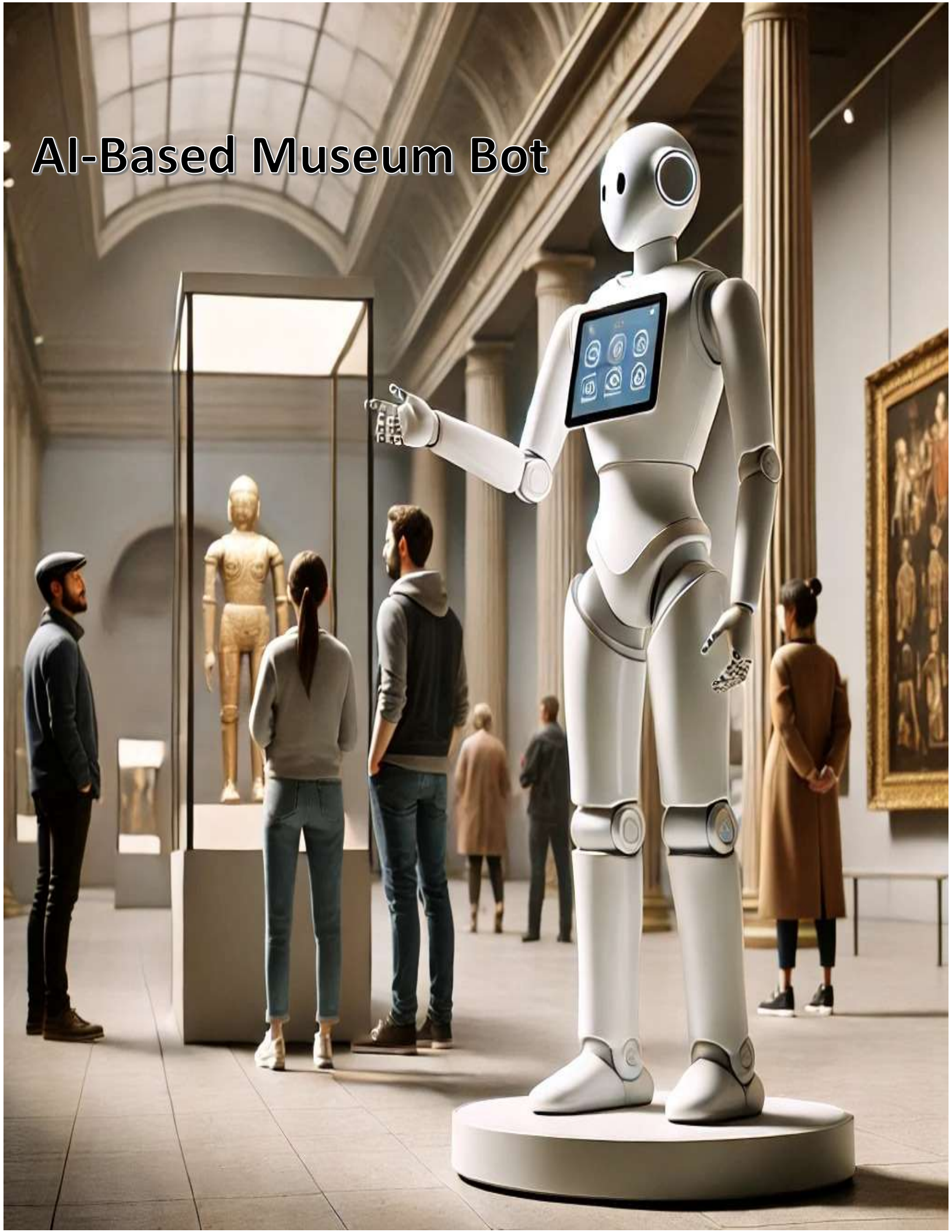
AI-Based Museum Bot

Group Report on Enterprise Project

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Presentation Video Link: https://drive.google.com/file/d/1x3IDIezvKrScbXz2ZpWzgzJ-tJ7Mo_6D/view

Model Card Link:

Executive Summary

This report examines the potential applications of robotic technology across multiple sectors, illustrating how robots can transform various environments. In airports, robots can enhance passenger experiences by providing real-time flight information, assisting with navigation, and supporting airport operations. In educational settings, robots serve as advanced teaching aids, offering consistent and interactive lessons to support both students and educators. Showrooms benefit from robotic integration by enabling interactive product demonstrations and detailed explanations, thereby improving customer engagement and satisfaction. In shopping malls, robots assist with navigation, locate stores and products, and facilitate customer services. The report demonstrates the robot's adaptability and effectiveness in improving operational efficiency and customer experiences across these diverse applications.

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Concept Page:

Figure 1: Concept Page

Keywords

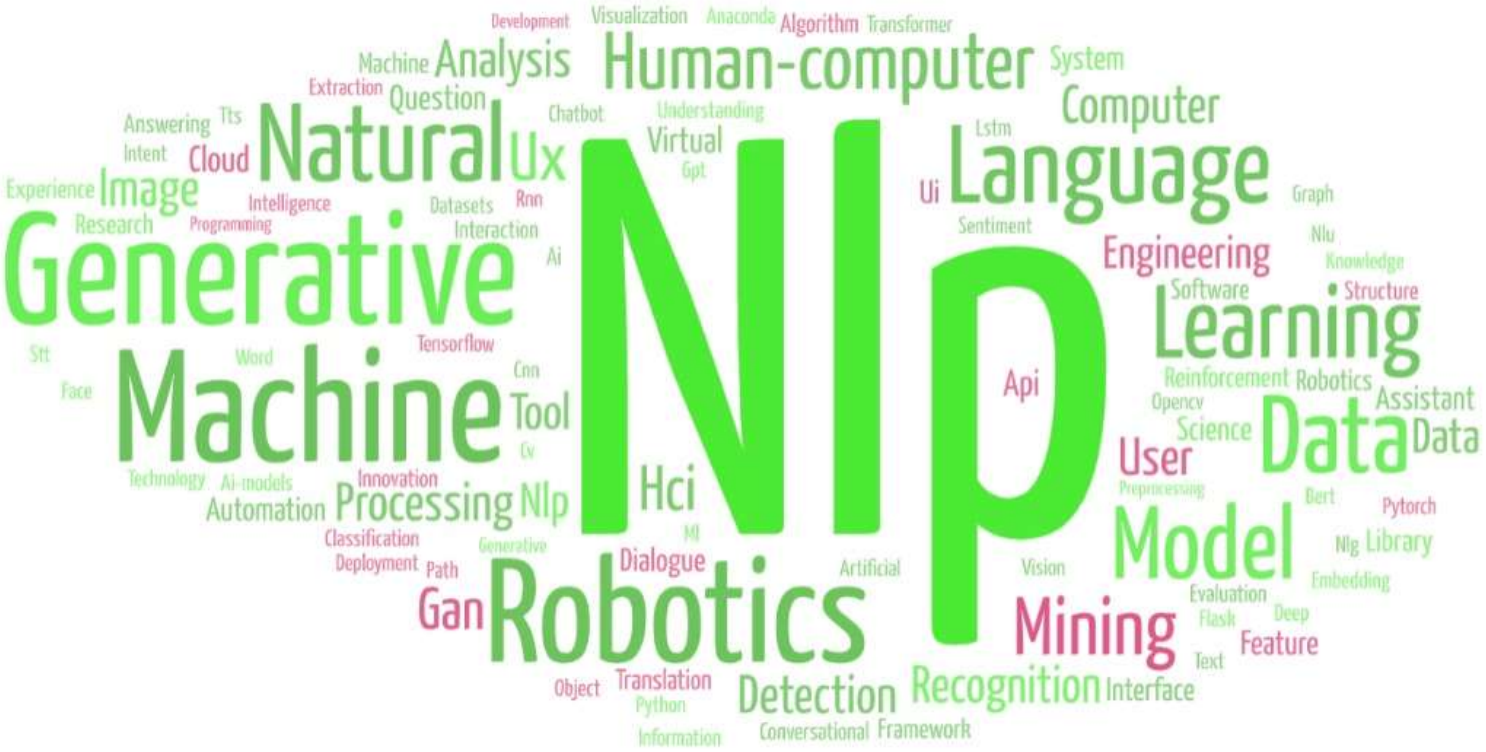

Figure 2: Keywords (WordCloud)

Introduction

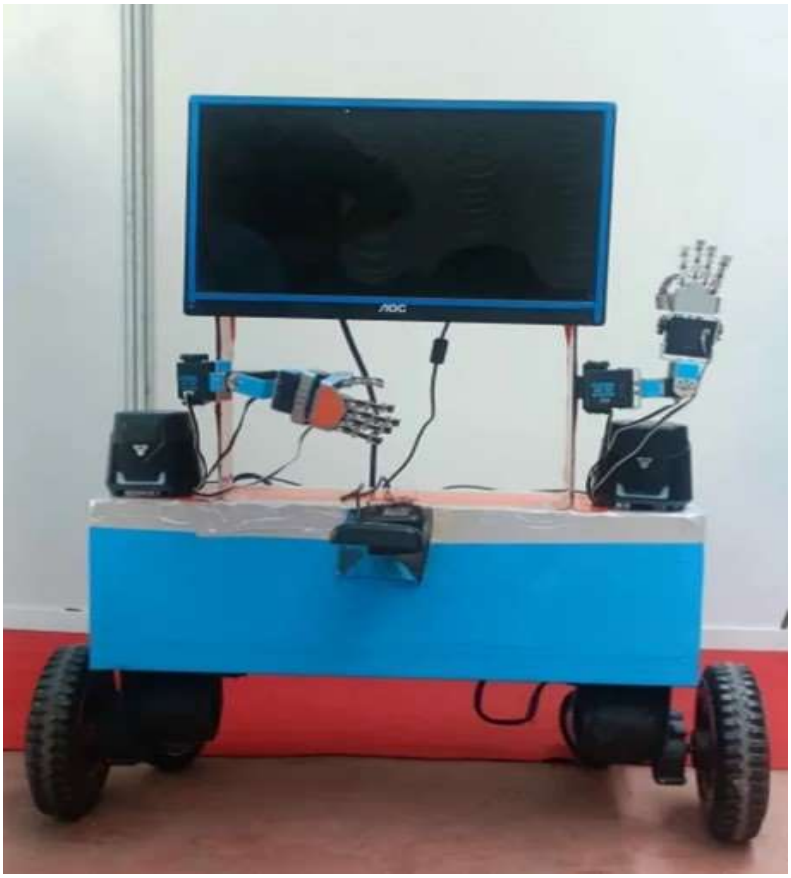

Figure 3: Robot After completion

comprehensive experience for visitors. The limited information displayed alongside artifacts frequently leaves visitors with unanswered questions, leading to an incomplete understanding of the exhibits. Additionally, these museums are often not equipped to accommodate physically challenged individuals, further limiting the accessibility and inclusiveness of the experience.

The prohibition of personal devices within museum premises also restricts visitors' ability to search for additional information, leaving them reliant on the minimal data provided. As a result, the museum experience can be less engaging and fails to fully convey the significance of the artifacts and the stories behind them. This lack of interaction and engagement not only detracts from the visitor experience but also diminishes the potential of museums to contribute to tourism in Nepal. Furthermore, the absence of technological advancements in these museums limits their appeal to tech-savvy visitors and hampers efforts to modernize the tourism sector.

Aim

- To enhance the museum experience by providing interactive and informative guidance to visitors.
- To make museums more accessible to physically challenged individuals.
- To integrate advanced technological solutions to modernize the museum experience.
- To promote tourism in Nepal by improving the overall visitor experience in museums

Objectives.

1. Interactive Guidance: Develop a robot capable of navigating museum premises, recognizing artifacts, and providing detailed explanations to visitors. The robot should also be able to answer visitors' questions using advanced NLP techniques.
2. Accessibility: Ensure that the robot can assist physically challenged visitors by providing necessary guidance and information in an accessible manner.
3. Technological Integration: Utilize computer vision, NLP, NLU, and NLG technologies to create a seamless and engaging experience for visitors. The robot should be able to recognize artifacts, process visitor inquiries, and generate appropriate responses.
4. Tourism Promotion: Enhance the appeal of museums to both local and international visitors by offering a modern, tech-driven experience that highlights the cultural and historical significance of the exhibits.
5. Future Scalability: Design the robot with the potential for scalability, allowing it to be adapted for use in other sectors such as airports, schools, showrooms, and malls.

Mission and Vision Statement

Figure 4: Mission and Vision Statement

Literature Review

This literature review examines the integration of robotics and AI in museums, focusing on natural language processing (NLP), natural language understanding (NLU), and computer vision. Robotic guides enhance visitor engagement through personalized tours and dynamic interactions. NLP and NLU enable robots to understand and respond to complex inquiries, while computer vision allows them to identify artifacts and navigate spaces. These technologies improve accessibility for visitors with disabilities and support multiple languages. The combination of these AI components results in more interactive and immersive museum experiences. However, challenges remain in ensuring reliability, accuracy, and smooth integration of various technologies. Future research should focus on improving scalability and adaptability across different cultural contexts and sectors. As these technologies evolve, their application in museums and other public spaces is expected to become increasingly common, transforming how we engage with cultural and historical artifacts.

Development Methodology:

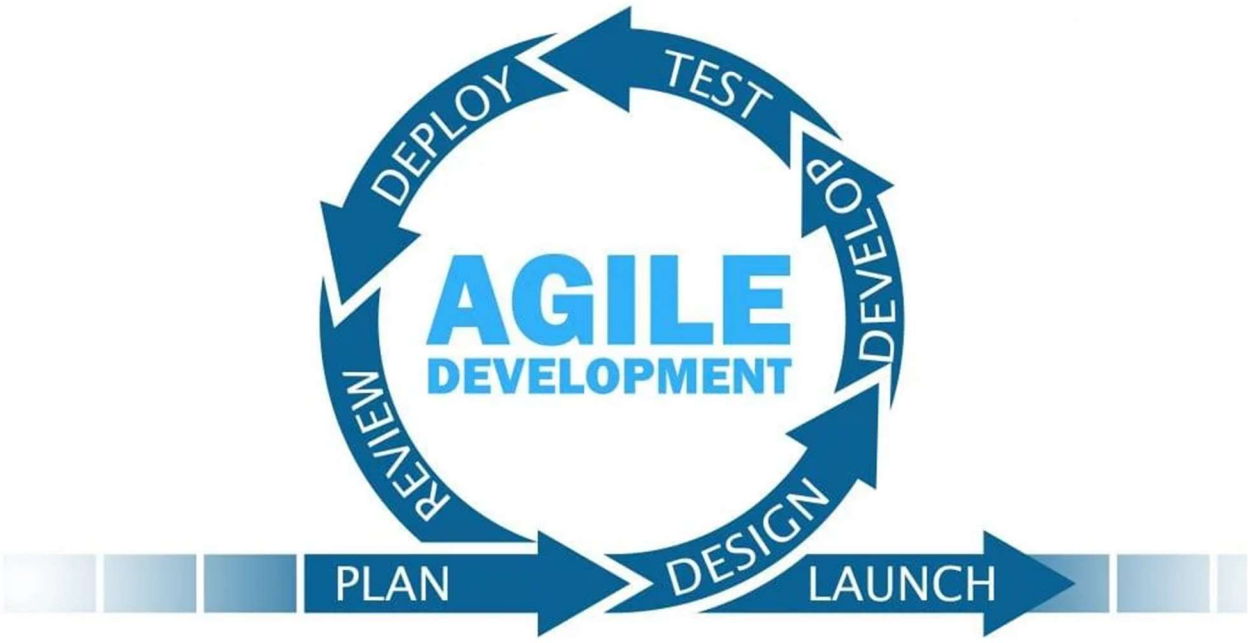

Figure 5: Agile Methodology

The project was developed using the agile methodology, which provided a flexible and iterative approach to managing the project's progress. Agile methodology facilitated effective communication among team members, allowing for continuous feedback and adjustments throughout the development process. By breaking down the project into smaller, manageable tasks, the team was able to focus on specific aspects of the robot's functionality, ensuring that each component was developed and tested thoroughly before moving on to the next stage.

Agile methodology also allowed for regular review sessions, where the team could assess the progress made and identify any potential issues or areas for improvement. This iterative approach enabled the team to stay on track and meet the project's deadlines while ensuring that the final product met all the requirements and expectations.

Tools and Technology Used

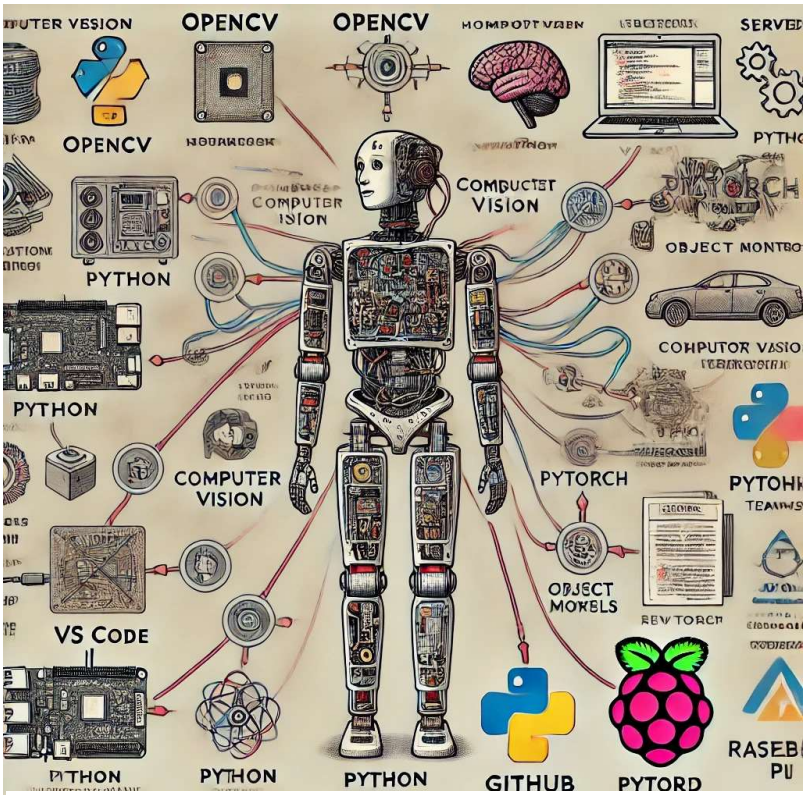

Figure 6: Tools and Technologies

The development of the museum robot involved the use of various tools and technologies, primarily focused on NLP, NLU, and NLG. Python was the main programming language used, along with several specialized libraries and frameworks, including PyTorch, Hugging Face's transformers, TensorFlow, and OpenCV. Anaconda was used as the environment manager, while Google Colab provided the necessary computing resources for training and testing the models. The Gemini API was utilized for integrating large language models (LLMs), and GitHub was employed for version control and project management.

These tools and technologies were instrumental in building the robot's capabilities, from artifact recognition to natural language processing and generation. Each tool played a specific role in the development process, contributing to the overall functionality and performance of the robot.

Integration

Integrating the software components with the hardware presented several challenges, particularly in ensuring smooth communication and execution of tasks between the two. The robot's hardware, which includes servo motors, cameras, a speaker, a microphone, and a monitor, had to be synchronized with the software processes to achieve the desired level of interaction and functionality.

The use of Arduino for controlling the robotic hand and the integration of computer vision for line following and artifact recognition required careful coordination between the software and hardware components. The camera systems had to be calibrated to accurately detect and recognize artifacts, while the microphones and speakers needed to be configured for clear and responsive communication with visitors. Additionally, the laptop's processor was used as the primary processing unit, which required optimization to handle the computational demands of the NLP and computer vision tasks.

The integration process involved extensive testing and fine-tuning to ensure that the robot could perform its tasks reliably and efficiently. Any discrepancies between the software and hardware components were addressed through iterative testing and adjustments, ultimately leading to a fully functional and interactive museum robot.

Functional and Non-functional Requirements

Functional Requirements:

1. **Artifact Recognition:** The robot must be able to identify and recognize artifacts within the museum premises using computer vision.
2. **Interactive Guidance:** The robot should provide detailed explanations of artifacts and answer visitor questions using NLP and NLG.
3. **Mobility:** The robot must be capable of navigating the museum using a line-following mechanism.
4. **Hand Gestures:** The robot should perform interactive hand gestures using servo motors to enhance visitor engagement.

Non-functional Requirements:

1. **Response Time:** The robot should provide responses to visitor inquiries within a few seconds to ensure a smooth and interactive experience.
2. **Reliability:** The robot must operate consistently without frequent breakdowns or interruptions.
3. **Scalability:** The robot's design should allow for future enhancements and adaptability to other sectors.
4. **Portability:** The robot should be of a manageable size, allowing it to move comfortably within the museum premises.

Project Plan

The project was executed in several stages, with a focus on meeting both hardware and software requirements within a month. The initial phase involved defining the project scope, setting objectives, and allocating tasks to team members. This was followed by the development of individual software components, including the NLP and computer vision systems, which were tested and refined iteratively.

Simultaneously, the hardware components were assembled and tested for functionality, ensuring that they could be integrated with the software systems. Regular progress reviews were conducted to assess the project's status and make any necessary adjustments. The final stage involved the integration of all components, followed by comprehensive testing to ensure that the robot met all the project requirements.

Throughout the project, agile methodology was employed to manage progress and ensure that all tasks were completed on time. The project's success was measured by the robot's ability to perform its intended functions reliably and effectively, providing an enhanced experience for museum visitors.

Possible Applications in Other Sectors

The museum robot's design and functionality can be adapted for use in various other sectors:

1. **Airports:** The robot can serve as a guide, assisting visitors with flight information, location services, and surveillance. It can also answer queries related to airport facilities and provide real-time updates.
2. **Schools:** The robot can be used as an educational tool, delivering lessons and assisting teachers in providing accurate and consistent information to students.
3. **Showrooms:** In automobile and gadget showrooms, the robot can act as a salesperson, offering detailed explanations of products and enhancing the customer experience through interactive demonstrations.
4. **Malls:** The robot can help shoppers navigate the mall, find stores and products, and assist with billing and other services.

Recommendation and Future Work

Upon testing, it was found that while the robot successfully navigated and performed its tasks, there were several areas for improvement. The robot's NLP capabilities, while functional, could benefit from further enhancement to provide more contextually relevant and nuanced responses. Additionally, the robot's size and mobility could be optimized to allow for easier movement within crowded spaces. Future work should also focus on making the robot more compact and efficient, as well as exploring additional applications in other sectors.

Conclusion

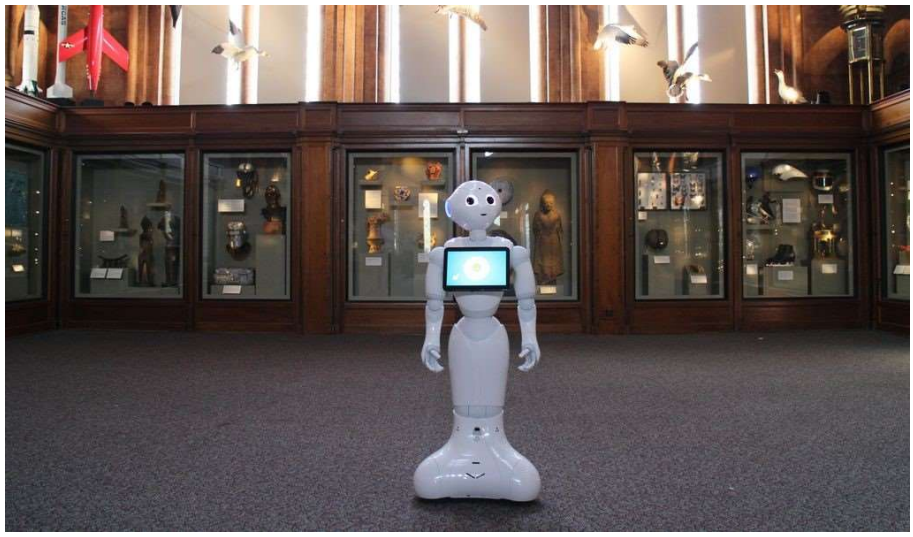

Figure 7: Production-Level Museum robot

The museum robot represents a significant advancement in enhancing the museum experience in Nepal. By integrating advanced technologies such as NLP, NLU, and computer vision, the robot provides an interactive and informative experience for visitors, making museums more accessible and engaging. The project demonstrates the potential of AI and robotics to transform traditional sectors, with broader applications in various industries. With further development and refinement, the robot could play a key role in modernizing museums and other public spaces, contributing to Nepal's tourism and education sectors.

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