Field of computer Engineering

Artificial Intelligence

GALALA UNIVERSITY
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Project Title (Animal Explorer for Kids)	In body test
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Program	Artificial intelligence
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❖ Content

1. Abstract

This report details the development of a Gradio application designed to classify animal images and provide additional educational context using a fine-tuned MobileNetV2 model and the Google PaLM API. The project,

titled "Animal Explorer for Kids," incorporates technologies such as TensorFlow, Keras, Google authentication, and Gradio to create an interactive learning tool for children. This document covers the project's objectives, the issues encountered and their resolutions, the testing phase, output results, conclusions, future work, and references.

- ## 2. Introduction

The growth of machine learning and AI technologies has opened up new avenues for educational tools. This project aims to leverage these

technologies to create an application that classifies animal images and generates informative descriptions for children. By fine-tuning the MobileNetV2 model and integrating with the Google PaLM API, the application provides an engaging way for kids to learn about animals. The project, named "Animal Explorer for Kids," is designed to enhance children's learning experiences by offering interactive and informative tools that make learning fun and effective.

- The application allows children to upload images of animals, which are then classified using a

state-of-the-art image recognition model. Following the classification, the application generates a description of the animal using advanced natural language processing techniques. This description is tailored to be educational and engaging for children, providing them with interesting facts and information about the animal.

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- 3. Objectives
- The primary objectives of this project are:

- 3.1 To develop a user-friendly Gradio application for classifying animal images.
- 3.2 To fine-tune the MobileNetV2 model for accurate image classification.
- 3.3 To integrate the Google PaLM API for generating educational descriptions about classified animals.
- 3.4 To enhance children's learning experiences through interactive and informative tools.
- 3.5 To ensure the application is accessible and easy to use for children of various ages.

- **3.6 To create a scalable and efficient system that can handle a large number of requests simultaneously.**
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- **4. Issues Found and How We Resolved Them**
- **4.1 Data Preparation Challenges**
- **Problem: Organizing and preparing a large dataset of animal images for training.**
- **Resolution: Implemented a data preparation function that automatically splits the dataset into training and validation sets, ensuring balanced category representation. This involved**

using the train_test_split method from the sklearn library to divide the dataset and using data augmentation techniques to increase the diversity of the training set.

- 4.2 Model Integration Issues
- Problem: Integrating the MobileNetV2 model with custom layers for fine-tuning.
- Resolution: Standardized the input and output formats for seamless integration and froze certain layers to avoid overfitting. This involved modifying the model architecture to include additional layers such as

GlobalAveragePooling2D, Dense, BatchNormalization, and Dropout layers to enhance the model's performance and prevent overfitting.

- 4.3 API Authentication Errors
- Problem: Authentication issues when accessing the Google PaLM API.
- Resolution: Implemented a robust authentication mechanism using Google service account credentials, ensuring secure and reliable API access. This involved using the google-auth library to handle the authentication

process and refreshing the access token as needed.

- 4.4 User Interface Design
- Problem: Ensuring the Gradio interface is intuitive and engaging for children.
- Resolution: Conducted user testing sessions with children to gather feedback and made iterative improvements to the interface design. This included simplifying the user interface, adding visual aids, and ensuring that the application is easy to navigate.
- 4.5 Performance Optimization

- **Problem: Ensuring the application runs efficiently on various devices.**
- **Resolution: Optimized the image processing and model inference code to reduce latency and improve performance on different hardware configurations. This involved resizing images to a consistent size, using efficient data handling techniques, and optimizing the model for inference.**
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- **5. Testing Phase**
- **5.1 Accuracy of Image Classification**

- **Objective: To ensure the MobileNetV2 model accurately classifies animal images.**
- **Method: Conducted extensive testing using validation datasets to measure accuracy and performance. The accuracy was measured by comparing the model's predictions with the ground truth labels and calculating metrics such as accuracy, precision, recall, and F1-score.**
- **5.2 Quality of Generated Descriptions**

- **Objective: To evaluate the quality and relevance of the descriptions generated by the Google PaLM**
- **API.**
- **Method: Reviewed generated texts for coherence, informativeness, and appropriateness for the target age group. This involved manually evaluating the descriptions to ensure they were engaging and educational for children. Feedback from educators and parents was also collected to ensure the descriptions met the educational goals.**

- **5.3 User Interface Usability**
- **Objective: To ensure the Gradio application provides a smooth and intuitive user experience.**
- **Method: Conducted user testing sessions and collected feedback for improvements. This included usability testing with children of different age groups to gather insights on how they interact with the application. Based on the feedback, changes were made to improve the user interface and overall user experience.**
- **5.4 Unit Testing**

- **Method: Conducted unit tests for individual functions to ensure they worked as expected. This included testing functions for data preprocessing, model inference, and API calls to ensure they performed correctly and efficiently.**
- **5.5 Integration Testing**
- **Method: Tested the entire application workflow to verify the integration of all components. This involved running end-to-end tests to ensure the application could handle the entire process from image upload to generating**

and displaying descriptions without errors.

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- 6. Output
- 6.1 Classification Results
- The project successfully developed a Gradio application that classifies animal images with high accuracy using a fine-tuned MobileNetV2 model. The model achieved an accuracy of 92% on the validation dataset, demonstrating its effectiveness in recognizing various animal species.
- 6.2 Educational Descriptions

- The application provides additional educational descriptions generated by the Google PaLM API, offering informative content suitable for children. These descriptions include interesting facts about the animals, their habitats, behaviors, and other educational information. For example, when an image of a lion is uploaded, the application not only classifies it as a lion but also provides a description about lions being the "king of the jungle," their social behavior in prides, and their role in the ecosystem.

- **6.3 User Feedback**
- **Collected feedback from users indicated high satisfaction with the application's performance and educational value. Users appreciated the interactive and engaging nature of the tool. Children found the application fun and informative, while parents and educators noted its potential as a valuable educational resource.**
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- **7. Conclusion**
- **The Animal Explorer for Kids application effectively integrates multiple AI technologies to**

provide a comprehensive educational tool. The application enhances learning experiences by allowing children to explore and learn about different animals interactively. The project demonstrates the potential of combining image classification with natural language generation to create informative and engaging educational tools. The high accuracy of the classification model and the quality of the generated descriptions ensure that the application provides a reliable

and valuable learning experience for children.

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- 8. Future Work
- Future work includes expanding the dataset to include more animal categories and refining the description generation for improved educational value. Additional features such as quizzes and interactive learning modules could be integrated to further enhance the educational experience. Exploring multi-language support to make the application accessible to a broader audience is also a key

area for future development. Furthermore, integrating augmented reality (AR) features could provide an even more immersive learning experience for children.

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- 9. References
- TensorFlow: An end-to-end open-source machine learning platform. https://www.tensorflow.org/
- Keras: The Python Deep Learning library. https://keras.io/
- Google PaLM API: An API for accessing Google's generative

language models. https://cloud.google.com/palm

- Gradio: A Python library for creating interactive user interfaces. https://gradio.app/
- scikit-learn: A Python module for machine learning. https://scikit-learn.org/
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