16.11.2024

CSE4288 Introduction to Machine Learning
Team Project Fall 2024
Group 9 Proposal

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Project Title And Description

Title: Child Drawing Classifier

Description: This project focuses on developing a machine learning model capable of classifying children's unique and imaginative drawings into predefined categories. By leveraging a dataset of hand-drawn images by children, this classifier aims to interpret the abstract and creative elements inherent in child artwork, addressing challenges such as limited labeled data and the unpredictability of artistic styles. The ultimate goal is to provide a tool with applications in education and child development, offering insights into cognitive and artistic growth while aiding in automated feedback and categorization.

1. **Problem Statement and Objectives**

Traditional image classification models can struggle with the abstract shapes, exaggerated proportions, and imaginative interpretations typical in children's artwork. Additionally, limited labeled data for this type of art makes it difficult to train models effectively, presenting a need for a robust approach that balances preprocessing, data augmentation, and model tuning.

This project aims to bridge the gap between machine learning and early childhood art by creating tools that understand and classify children's unique drawings. Machine learning models that can recognize and categorize child art have potential applications in educational and developmental tools, allowing for automated feedback, categorization, or even insight into children's cognitive and artistic growth.

2. **Brief overview of the dataset**

This dataset will feature a collection of children's hand-drawn images, organized into ten categories like animals, plants, everyday objects, and simple scenes. Each category will have around 300 images, capturing the unique creativity and style found in kids' drawings. Since children's art can be quite varied – sometimes detailed, sometimes simple, and often imaginative – the dataset presents an interesting challenge for image classification.

3. Proposed Methodologies and Timeline

3.1 Methodology

3.1.1 Preprocessing

For preprocessing, we plan to apply data augmentation and normalization. Data augmentation will help improve the model's generalizability by incorporating techniques such as random rotations, flipping, and cropping. Additionally, normalization between 0 and 1 will be used to accelerate the training process and enhance model performance.

3.1.2 Model Architecture

Our model will consist of multiple convolutional layers, each followed by ReLU activation and max-pooling to reduce spatial dimensions. After flattening the output from the final convolutional layer, a fully connected layer will be used to interpret high-level patterns. A softmax layer will serve as the final layer to classify inputs into one of our classes.

3.1.3 Model Training and Optimization

We will employ categorical cross-entropy as the loss function, as it is well-suited for multi-class classification tasks. The Adam optimizer will be chosen for its adaptive learning rate properties, which support faster and more stable convergence. To optimize model performance, we will experiment with various learning rates, batch sizes, and layer configurations.

3.1.4 Evaluation Metrics

Our main metric will be accuracy, representing the percentage of correct predictions. Additionally, we will use precision, recall, and F1 scores to gain insights into the model's performance for each class, which is particularly useful if the dataset is imbalanced.

3.2 Timeline

Week 1: Project Initiation

- **Dataset Collection**: Collect and organize the dataset of children's drawings into 10 categories.

- **Dataset Overview**: Review dataset structure and ensure sufficient data for each class.

Week 2: Data Preprocessing and EDA

- **Data Preprocessing**: Apply data augmentation (rotation, flipping, cropping) and normalization (0-1 scale).
- **Exploratory Data Analysis (EDA)**: Analyze class distributions, visualize sample images, and check for class imbalances.

Week 3: Model Development

- **Model Design**: Select and design the CNN architecture for classifying children's drawings.
- **Model Coding & Initial Training**: Implement the model and train it on the dataset. Evaluate performance with basic metrics.

Week 4: Model Evaluation and Optimization

- **Model Evaluation**: Test the model on validation/test data, measure accuracy, precision, recall, and F1 score.
- **Optimization**: Tune hyperparameters, improve model architecture, and apply cross-validation.

Week 5: Finalization and Presentation Preparation

- **Final Testing**: Conduct the final test and assess model performance on the test set.
- **Results Analysis**: Summarize findings, create visualizations (accuracy curves, confusion matrix), and prepare a report.
- **Presentation**: Prepare the final presentation and documentation for project delivery.