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AUTOMATED CLOTHING IMAGE CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORKS (CNNS)

FISAC REPORT

Submitted by

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1. Problem Statement

The problem we're solving is automating the categorisation of clothing items to support a fashion exploration app. Currently, if we upload a product image and details, there's a chance it may not be categorised correctly without manual intervention. This manual sorting is time-consuming and can lead to mistakes. By creating an automated model, we can accurately categorise clothing items into their correct categories, reducing manual work and increasing the reliability of product organisation.

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2. Scope of the Work

This work aims to develop an efficient, automated image classification system for clothing. The main steps are:

1. **Data Preparation**: Loading the Fashion MNIST dataset, reshaping, and normalising images to ensure compatibility with the model and improved learning.
2. **Model Design**: Construct a CNN model suited explicitly for image classification tasks, with layers designed to detect patterns and distinguish among clothing types.
3. **Model Training and Evaluation**: Train the model on a large dataset and evaluate its performance with various metrics, ensuring it generalises well to new, unseen data.
4. **Visualisation and Insights**: Using evaluation tools to understand model strengths and limitations in classifying clothing items.
5. **Potential Applications**: The developed model can be applied to similar image classification tasks and is valid for e-commerce, inventory management, and other applications needing organised product categorisation.

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3. Comparative Description of Existing Work/Problem

Existing Approaches and Classification Challenges

Clothing item classification has unique challenges due to overlapping features in categories (e.g., shorts and skirts) and variety within each type. Traditional image classification models, which don’t utilise spatial patterns as effectively, often struggle with this complexity.

Why CNNs?

1. **Pattern Recognition**: CNNs are excellent at detecting shapes, edges, and textures in images, which is critical to distinguishing clothing items.
2. **Efficient Processing**: CNN layers allow for dimensional reduction (through max-pooling), making the model efficient and accurate without overwhelming computational resources.
3. **Versatility**: CNNs are widely used across various applications beyond image classification, such as object detection, segmentation, and more. This versatility makes them ideal for scalable applications.

Limitations in Traditional Approaches

- **Difficulty with Similar Classes**: Traditional models often need to be more accurate with items with subtle differences.
- **Resource Intensive**: Larger datasets require more memory and computational power for accurate results.
- **Lack of Interpretability**: In traditional neural networks, it can be challenging to understand the basis of the model's decision-making.

This project aims to mitigate these limitations by focusing on a CNN architecture, making image classification more efficient and interpretable.

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4. Implementation Summary

This project leverages a Convolutional Neural Network (CNN) designed for image classification tasks. The model follows these steps:

1. **Data Preprocessing**: Images are reshaped and normalised to enhance model training and ensure data fits the CNN input format.
2. **Model Design**: A CNN model with two convolutional layers and max-pooling operations is built to extract features from images. After feature extraction, dense layers process the features for final classification.
3. **Model Training and Evaluation**: The model is trained on labelled clothing images and evaluated on a test dataset to determine accuracy, achieving 93% accuracy, which indicates effective generalisation.
4. **Performance Visualization**: Key metrics such as confusion matrix, classification report, and ROC curves provide insights into model performance for each class.

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5. Conclusion

The CNN model successfully classifies clothing images into distinct categories with high accuracy (93%) on test data. This model significantly reduces manual categorisation efforts in the fashion exploration app by using convolutional layers to capture spatial patterns and classification metrics to assess individual category performance. It has shown that CNNs are effective for this classification task, making them suitable for real-world applications in automated clothing categorisation. This work demonstrates the potential of deep learning in streamlining tasks traditionally reliant on human input.