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FOOD IMAGE CLASSIFICATION

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**Interim Progress Report**

**Background Research and Literature:**

**Background:**

Food image classification is a critical application of computer vision that has gained significant attention in recent years. The advent of deep learning techniques has enabled remarkable improvements in the accuracy and efficiency of image classification tasks. One of the most promising approaches in this domain is the use of convolutional neural networks (CNNs), which have demonstrated superior performance in various image-related tasks.

**Food Image Classification** is essential for various applications, including dietary monitoring, nutrition analysis, and food quality assessment. Traditional methods for food recognition often rely on handcrafted features and shallow learning techniques, which may not capture the complex patterns and variations in food images effectively. Deep learning models, particularly CNNs, have revolutionized this field by learning features directly from raw image data, leading to more accurate and robust classification systems.

**Literature Review:**

**Convolutional Neural Networks (CNNs):**

CNNs are a class of deep learning models specifically designed for processing structured grid data, such as images. They consist of multiple layers, including convolutional layers, pooling layers, and fully connected layers, which work together to extract and learn hierarchical features from images.

* LeNet-5 was one of the earliest CNN architectures and demonstrated the effectiveness of CNNs in image classification tasks.
* AlexNet significantly advanced the field by winning the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) with a deep architecture and large-scale training.
* VGGNet introduced deeper networks with smaller convolutional filters, enhancing feature extraction capabilities.

**MobileNet:**

MobileNet is a lightweight CNN architecture designed for mobile and embedded vision applications. It utilizes depthwise separable convolutions, which split convolution operations into depthwise convolutions and pointwise convolutions. This approach reduces the number of parameters and computational complexity, making MobileNet suitable for resource-constrained environments.

* MobileNetV1 introduced the depthwise separable convolution and demonstrated its efficiency on various benchmark datasets.
* MobileNetV2 (Sandler et al., 2018) improved upon V1 by incorporating linear bottleneck layers and inverted residuals, further enhancing the model's performance and efficiency.

**Data Augmentation and Preprocessing:**

Effective data preprocessing and augmentation techniques are crucial for improving the performance and robustness of deep learning models. Data augmentation involves generating new training samples by applying transformations such as rotation, flipping, and zooming. These techniques help the model generalize better and prevent overfitting.

**Evaluation Metrics:**

Evaluating the performance of classification models involves using various metrics, including accuracy, precision, recall, and F1-score. These metrics provide insights into the model's ability to correctly classify images and handle imbalanced datasets.

**Summary Of Progress To Date:**

**Dataset Collection and Preprocessing:**

Data Collection: Collected food images from publicly available sources to create a diverse dataset covering various food categories.

Preprocessing: Resized images to 224x224 pixels, normalized pixel values, and applied data augmentation techniques such as rotation, flipping, and zooming to enhance the training dataset.

**Model Development:**

* **Model Selection:** Chose MobileNet due to its efficiency and performance in image classification tasks.
* **Model Implementation:** Built and trained the MobileNet model using TensorFlow and Keras. Implemented custom layers to adapt the model for food classification.
* **Training**: Fine-tuned the pre-trained MobileNet weights on the food image dataset.

**Ethical, Legal, Professional, and Social Considerations:**

* The dataset used for training does not include sensitive or private information. Images are sourced from public repositories.
* Verified that all images used in the dataset are legally permissible for use in the project.
* Following best practices in software development, including version control(github), documentation, and code reviews. Ensure that the model's implementation is reproducible and maintainable.

**Project Plan :**

**Objectives:**

* **Dataset Preparation:** Complete data collection and preprocessing, including augmentation.
* **Model Development:** Design and implement the MobileNet-based model for food image classification.
* **Model Evaluation:** Assess the model's performance using various metrics and make improvements based on evaluation results.
* **Documentation and Reporting:** Document the project, including methodology, results, and future work.

**Appendices:**

**Dataset Description**

The dataset used for the food image classification project contains 24,000 unique images. These images cover 35 different varieties of both Indian and Western appetizers, ensuring a diverse and representative collection for model training and evaluation.

**Key Features**

**Image Variety**: The dataset includes a wide range of food items from popular Indian and Western cuisines, such as Butter Naan, Pizza, Samosa, and Ice Cream.

**Diversity**: Images are sourced from various Google resources, capturing different food presentations, contexts, and lighting conditions.

**Purpose**: This dataset provides a solid foundation for developing and testing robust food image classification algorithms. It encourages exploration and innovation in the field of food image classification.

**Food Categories:**

The dataset includes images of the following food items:

* **Indian Dishes**: Butter Naan, Chole Bhature, Dhokla, Idli, Paani Puri, Pav Bhaji, etc.
* **Western Dishes**: Burger, Pizza, Fries, Hot Dog, Donut, Ice Cream, etc.

**References**:

* P. N. V., P. Kumari, P. N., S. R., and D. H. Jagadish, "Indian Food Image Recognition with MobileNetV2," \*International Research Journal of Engineering and Technology (IRJET)\*, vol. 8, no. 8, pp. 1-8, Aug. 2021. [Online]. Available: [https://www.irjet.net/archives/V8/i8/IRJET-V8I8102.pdf](%5b1%5d%20P.%20N.%20V.,%20P.%20Kumari,%20P.%20N.,%20S.%20R.,%20and%20D.%20H.%20Jagadish,%20%22Indian%20Food%20Image%20Recognition%20with%20MobileNetV2,%22%20*International%20Research%20Journal%20of%20Engineering%20and%20Technology%20(IRJET)*,%20vol.%208,%20no.%208,%20pp.%201-8,%20Aug.%202021.%20%5bOnline%5d.%20Available:%20https:/www.irjet.net/archives/V8/i8/IRJET-V8I8102.pdf)
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