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Research Article

AI-Based Symbol Recognition and Image Classification System

Vighneshwari N

Department of Computer Science ,Immaculate College For Women,Chinnakanganankuppam ,Cuddalore
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Abstract

This research presents an "AI-Based Symbol Recognition and Image ClassificationSystem" that utilizes convolutional neural networks(CNN) to identify and classify various typesof images automatically. The proposed system is capable of recognizing multiple categoriessuch as animals, birds, flowers, leaves, currency symbols, Tamil digits, and plant disease images.The system is designed using Python, TensorFlow, and Flask framework to create an intelligentweb-based application that allows users to upload images and receive real-time classificationresults.

Keywords - Artificial Intelligence, Image Classification, Convolutional Neural Network, SymbolRecognition, Deep Learning.I

Introduction

Artificial Intelligence has transformed the way computers interpret visual information. Image classification is a core application of computer vision that enables machines to recognize patterns and objects in digital images. With the advancement of deep learning algorithms, particularly Convolutional Neural Networks (CNNs), automated image recognition systems have achieved remarkable success in various fields.

Symbol recognition systems are increasingly used in applications such as currency identification, agricultural disease detection, wildlife monitoring, and language recognition. Manual identification of symbols or objects in images is often time-consuming and prone to human error. Therefore, an automated intelligent system capable of recognizing and classifying images accurately is highly beneficial.

The AI-Based Symbol Recognition and Image Classification System aims to provide a unified platform capable of recognizing multiple types of symbols and objects from uploaded images. The system utilizes deep learning techniques to analyze image features and classify them into predefined categories. The proposed model is trained on a structured dataset containing various classes such as animals, birds, flowers, leaves, currency symbols, Tamil numbers, and plant disease images.

Literature Review

Image classification and symbol recognition tasks are widely used in several real-world applications. However, traditional identification methods depend on manual analysis or simple rule-based algorithms.

Existing Image

Existing image recognition systems aregenerally limited to specific domains. Forexample, plant disease detection systems focusonly on agricultural datasets, while currencyrecognition systems are designed to detect onlymonetary symbols. These domain-specificmodels cannot perform multi-category classification tasks.

Most traditional image classification techniques rely on handcrafted features such as color histograms, texture descriptors, and edge detection methods. These methods require manual feature extraction and often fail to capture complex patterns present in images. Another limitation of traditional approaches is their inability to generalize well across different datasets. When new image categories are introduced, the system must be redesigned or retrained extensively. This reduces the flexibility and scalability of such systems.

Furthermore, many existing systems do not provide a user-friendly interface for interacting with the model. Users often need to run complex command-line programs or specialized software to perform predictions. These limitations highlight the need for an advanced image recognition system that can automatically learn features from images and
provide accurate classification results through a simple and interactive interface.

Proposed System

The proposed system introduces an AI-BasedSymbol Recognition and Image ClassificationSystem that uses Convolutional NeuralNetworks (CNN) for automated imageclassification. The system is designed torecognize multiple categories of imagesincluding animals, birds, flowers, leaves,currency symbols, Tamil digits, and plant diseases.

The architecture of the proposed system consistsof several components including datasetpreparation, image preprocessing, CNN modeltraining, prediction module, and a web-based user interface. The dataset is organized intostructured directories where each class containslabeled images.During the training phase, the CNN model learns important visual features from the imagessuch as edges, textures, and patterns. The trained model is then saved and integrated into a Flask-based web application. Users can upload images through the web interface, and the model predicts the corresponding category. The system provides prediction results along with confidence scores to indicate the reliability of the classification. The proposed solution improves accuracy, automation, and usability compared to traditional systems.

SYSTEM ARCHITECTURE

The system architecture consists of the following components:

- Image Input Module
- Image Preprocessing Module
- CNN Feature Extraction Layer
- Classification Layer
- Prediction Output Module
- Web Interface (Flask Application)



The input image is first preprocessed and resized before being passed to the CNN model. The CNN extracts hierarchical features from the image and classifies it into one of the predefined categories.

Dataset Description

The dataset used in this project consists of multiple classes organized in a structured folder hierarchy. Each class contains labeled images used for training and testing the model.

The dataset includes categories such as:

- Animals (Cat, Dog, Elephant)
- Birds (Parrot, Dove, Peacock)
- Flowers (Rose, Jasmine, Hibiscus)
- Leaves (Mango, Neem)
- Currency Symbols (Dollar, Euro, Yen, Rupee)
- Tamil Digits (Zero, One, Two)
- Plant Disease Images

The dataset is divided into training and validation sets to evaluate the performance of the model.

Methodology

The system uses Convolutional Neural Networks (CNN) to perform image classification. The CNN architecture consists of multiple convolution layers, pooling layers, and fully connected layers.

The training process involves:

- Image preprocessing
- Data augmentation
- CNN model training
- Model validation
- Prediction

The trained model learns to identify unique patterns in each class of images.

Results And Performance Analysis

The performance of the proposed model is evaluated using accuracy and loss metrics. During training, the model achieved high classification accuracy across multiple categories.

Performance evaluation metrics include:

- Accuracy
- Precision
- Recall
- Confusion Matrix

Graphs such as Training Accuracy Curve and Loss Curve are used to analyze the model performance.

Conclusion

The AI-Based Symbol Recognition and Image Classification System successfully demonstrates the capability of deep learning algorithms to perform automated image classification tasks. By utilizing Convolutional Neural Networks, the system can accurately recognize and classify multiple types of symbols and objects. The proposed system provides an efficient and user-friendly platform for image classification through a web interface. It reduces manual effort and improves accuracy compared to traditional methods. The system can be further enhanced by incorporating real-time video recognition, larger datasets, and more advanced deep learning models

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