**link:**<https://www.researchgate.net/profile/Swarup-Ghosh-4/publication/335230401_A_Robust_Multi-label_Fruit_Classification_Based_on_Deep_Convolution_Neural_Network/links/5ed9d055299bf1c67d41a746/A-Robust-Multi-label-Fruit-Classification-Based-on-Deep-Convolution-Neural-Network.pdf>

**Dataset:** <https://www.kaggle.com/datasets/moltean/fruits>

**Tittle:**A Robust Multi-label Fruit Classification Based on Deep Convolution Neural Network

**introduction:T**he research paper proposes a fruit recognition and [classification scheme](https://en.wikipedia.org/?curid=3410264) based on deep [convolution](https://en.wikipedia.org/?curid=7519)al neural network (CNN) to address the challenges in [multi-label](https://en.wikipedia.org/?curid=7466947) fruit classification in [computer vision](https://en.wikipedia.org/?curid=6596). The paper discusses the [limitations](https://en.wikipedia.org/?curid=9401640) of existing methods such as [support vector machine](https://en.wikipedia.org/?curid=65309) (SVM) and presents a CNN-based approach for [multi-label](https://en.wikipedia.org/?curid=7466947) fruit classification and recognition. The proposed method is evaluated using four normal fruits (apple, lemon, tomato, and plum) and achieves approximately 98% [accuracy](https://en.wikipedia.org/?curid=41932) in classifying 1200 fruit images, indicating its potential for agro-based applications.

The paper outlines the [background](https://en.wikipedia.org/?curid=312421) of fruit and vegetable classification in [computer vision](https://en.wikipedia.org/?curid=6596), highlighting the similarity in [shapes](https://en.wikipedia.org/?curid=169191), [textures](https://en.wikipedia.org/?curid=421679), and [colors](https://en.wikipedia.org/?curid=5921) of these objects. It also discusses the [limitations](https://en.wikipedia.org/?curid=9401640) of traditional [computer vision](https://en.wikipedia.org/?curid=6596) systems and the increasing popularity of machine learning techniques, particularly [artificial neural network](https://en.wikipedia.org/?curid=21523) (ANN)-based machine learning for [multi-label](https://en.wikipedia.org/?curid=7466947) classification in [computer vision](https://en.wikipedia.org/?curid=6596).

**Result**:The proposed CNN [architecture](https://en.wikipedia.org/?curid=21296224) for [multi-label](https://en.wikipedia.org/?curid=7466947) fruit classification is described, detailing the [convolution](https://en.wikipedia.org/?curid=7519), [max pooling](https://en.wikipedia.org/?curid=40409788), ReLU, and [batch normalization layers](https://en.wikipedia.org/?curid=57222123). The experimental results show that the CNN-based approach outperforms multi-class SVM for fruit classification, achieving approximately 98% [accuracy](https://en.wikipedia.org/?curid=41932) compared to 84.38% and 82.62% for the SVM approach on the FIDS30 and Fruits-360 databases, respectively.

**conclusion:**The paper concludes that the proposed CNN-based scheme offers improved computational cost for multi-class fruit classification and recognition compared to traditional methods and could be utilized in vision-subsystem-based control applications in the agro-industry. The potential for future work includes extending the model to classify all 30 and 81 classes in the FIDS30 and Fruits-360 databases, respectively, and predicting harvesting time and fruit spoilage.