**COMP-8157 Advanced Database Topics**

Project Proposal

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**Submitted By:**

Group - (Data Heist)

Ashutosh Metha (110135928)

Veda Kothadia (110126104)

Dhvanil Vaghasiya (110148955)

Dhaval Koradiya (110135643)

**Submitted To:**

Dr. Shafaq Khan

**Fruit Classification Comparison Based on CNN**

Ashutosh Mehta1, Veda Kothadia1, Dhvanil Vaghasiya1, Dhaval Koradiya1

Computer Science Department, University of Windsor, Windsor, ON.

*Abstract:* Agriculture is becoming a science rather than an art. Fresh produce is in greater demand, but there are fewer field labourers available. By boosting productivity and lowering the need for human labour, automation enabled by contemporary technology can lower expenses for farmers and increase agricultural yields. Modern farming methods, like Deep Neural Networking, can help farmers optimize their operations and save labour expenses dramatically. By distinguishing between fruits and vegetables, a new picture classification technique utilizing lightweight Convolutional Neural Networks (CNN) is intended to speed up the checkout procedure at retail establishments. With this strategy, a new dataset containing three fruit classes—both inside and outside of plastic bags—is introduced. The CNN design incorporates a number of input variables, including an RGB centroid from K-means clustering, an RGB histogram, and a single RGB colour, to improve classification accuracy. Modern technology can automate processes more effectively and with less need for human intervention, saving farmers money and increasing agricultural yields. Fruit trees can grow taller and labour costs can be significantly reduced by using methods like Deep Neural Networking to categories fruits and optimize farming procedures.

Keywords— Deep Learning, Convolutional Neural Networks (CNNs), Image Classification, Machine Learning.

# **Problem Description**

The demand for fresh produce is steadily increasing, driven by growing health awareness and changing dietary habits expand more However, this rise in demand coincides with a shrinking agricultural workforce. Traditionally, the identification and pricing of fruits and vegetables at retail checkouts have relied on manual processes, which can be time-consuming and prone to errors. This can lead to inefficiencies in the checkout process, impacting customer experience and store productivity.

This research aims to address the challenge of manual fruit and vegetable identification at retail checkouts by developing a novel image classification system. This system will leverage the power of lightweight Convolutional Neural Networks (CNNs), a type of deep learning algorithm particularly adept at image recognition tasks. We propose the creation of a unique dataset encompassing various fruit classes, both bagged and unbagged, to train and validate the CNN model. To achieve high classification accuracy, the CNN architecture will incorporate a combination of image features, including RGB colour information, histograms, and centroids derived from K-means clustering.

The primary objective of this project is to demonstrate the feasibility and effectiveness of using CNNs for automated fruit and vegetable identification at retail checkouts. We aim to achieve a high level of accuracy in classifying different fruits, regardless of whether they are bagged or loose. This system has the potential to significantly expedite the checkout process, leading to improved customer experience and increased efficiency for retail stores.

# **Motivation**

The ever-increasing demand for fresh produce presents a complex challenge for the agricultural industry. While consumer desire for healthy and vibrant fruits and vegetables grows, the workforce available to harvest and manage this bounty shrinks. This imbalance creates a strain on the entire food supply chain, with inefficiencies manifesting most acutely at the final consumer touchpoint: the checkout lane. Traditional manual identification of fruits and vegetables is a time-consuming and error-prone process. Cashiers must possess a vast knowledge of produce varieties, differentiate between subtle variations in appearance, and factor in bagging or packaging that might obscure key features. This human element introduces delays and inconsistencies, leading to frustrated customers and bottlenecks in store operation. Streamlining this process through automation presents a compelling opportunity to improve efficiency, reduce costs, and enhance the overall customer experience.

This project delves into the exciting realm of deep learning, specifically the application of Convolutional Neural Networks (CNNs), to revolutionize fruit and vegetable identification at retail checkouts. CNNs excel at image recognition tasks, making them ideally suited for analyzing produce pictures and accurately classifying the items captured. By leveraging this technology, we aim to develop a novel image classification system that can automate the checkout process. This system would function by capturing an image of the fruit or vegetable using a camera integrated into the checkout lane. The captured image would then be fed into the CNN model, which has been trained on a meticulously curated dataset encompassing various fruit classes, both bagged and unbagged. To achieve exceptional classification accuracy, the CNN architecture will explore incorporating different image features. These features could include not just the overall RGB color information of the produce, but also more nuanced details like color histograms and centroids derived from K-means clustering. By incorporating these diverse image characteristics, the CNN model can learn to distinguish between different fruits even with slight variations in appearance or packaging.

A successful implementation of this project has the potential to create a ripple effect of positive change throughout the food industry. Customers can experience faster checkout times, leading to increased satisfaction and loyalty. Retail stores can benefit from streamlined operations, potentially reducing labor costs and improving staff productivity. Beyond the immediate benefits, this project holds the key to unlocking further innovation in the food supply chain automation. The technology developed here could be adapted to automate other critical tasks, such as inventory management and product quality control. Furthermore, the success of this project would pave the way for the exploration of CNNs in other retail applications, showcasing the transformative potential of deep learning in revolutionizing the customer experience and boosting operational efficiency across diverse industries.

1. SOLUTION

At the heart of this project lies the power of Convolutional Neural Networks (CNNs). These deep learning algorithms are adept at recognizing patterns within images, making them ideal for fruit and vegetable classification. We will develop a CNN model specifically trained on a unique dataset of fruit and vegetable images. This dataset will encompass a diverse range of classes, including commonly encountered produce items, both bagged and loose. To enhance the model's ability to differentiate between subtle variations, the dataset will be meticulously curated to account for different lighting conditions, ripeness levels, and potential packaging obstructions.

Beyond the core CNN architecture, we will explore incorporating additional technologies to enrich the image analysis process. K-means clustering, a machine learning technique for data classification, might be utilized to identify key colour centroids within the fruit images. These centroids represent dominant colour clusters and can provide valuable information for the CNN to distinguish between similar-looking fruits. Additionally, we will investigate the use of colour histograms to capture the distribution of colour information within the image. This holistic approach, combining CNNs with complementary image analysis techniques, aims to achieve exceptional classification accuracy, ensuring a smooth and efficient checkout experience.

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