APPENDIX 1 – L7 COMPUTER VISION PROBLEM OUTLINE FORM

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| **1. Group members (names and BU email addresses)** |
| 1. Sai Sujith |
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| **2. Title**  AI-Powered Food Inspection: Automated Classification of Fresh and Stale Fruits & Vegetables |
| **2. Problem description**  Maintaining the quality and safety of product in commercial environments including supermarkets, warehouses, and food processing plants depends critically on food inspection. Efficient inspection procedures reduce food waste while protecting consumer health by limiting the distribution of stale or rotten fruits and vegetables. Traditional inspection approaches, on the other hand, need physical labour, which is time-consuming, inconsistent, and prone to human mistake. Inefficient quality control can result in financial losses, food waste, and poor customer satisfaction. To solve these issues, this project suggests developing an AI-powered food inspection system that uses computer vision algorithms to discern between fresh and stale vegetables. Palakodati *et al.* (2020) proved the efficacy of deep learning-based categorization of fresh and rotting fruits using Convolutional Neural Networks (CNNs). Similarly, Hossain *et al.* (2021) used deep learning models to detect fruit ripeness and rotting, which improved food quality assessments.  The suggested method would make use of a diversified dataset that includes photographs of both fresh and stale vegetables under various situations. Bhatt *et al.* (2019) stressed the significance of dataset diversity and augmentation strategies in enhancing model generalization. This research will use data augmentation techniques such as rotation, brightness modifications, and noise addition to improve robustness. Additionally, this study will look into the effect of dataset size on model accuracy. Rahman *et al.* (2022) investigated dataset efficiency when training deep learning models for agricultural applications, which will inform our dataset optimization technique. This project intends to create a highly accurate, automated categorization model through error analysis and performance evaluation, which will contribute to better food quality management, waste reduction, and increased consumer trust. |
| **3. Aims and objectives** |
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| The project's goal is to create an AI-powered food inspection system that automatically distinguishes between fresh and stale fruits and vegetables, increasing the effectiveness and precision of food quality evaluation.   1. Collect and organize a wide array of photographs of fresh and stale fruits and vegetables, with enough variance in lighting, angles, and backdrops. 2. Create a deep learning model capable of detecting fresh and stale products with high accuracy. 3. Use data augmentation approaches to improve model generalization and robustness under a variety of environmental situations. 4. Analyze the effect of dataset size on model performance by training with various data proportions and comparing accuracy trends. |
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| **4. Approach** |
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| In order to carry out this project successfully, we will start by gathering and preparing the dataset using Kaggle's "Fresh and Rotten/Stale Fruits and Vegetables Classification Dataset," (<https://www.kaggle.com/datasets/swoyam2609/fresh-and-stale-classification>) which contains high-quality photos of fresh and stale produce like tomatoes, cucumbers, carrots, apples, oranges, and bananas, will be the first step in successfully completing this project. Additionally, by recording real-world variations such various lighting conditions, angles, and backdrops, we will create our own dataset to enhance generalization. The durability of the model in a variety of environmental situations will be further improved by data augmentation techniques like rotation, brightness adjustments, noise addition, and blurring.  We will test many Convolutional Neural Network (CNN) architectures, such as ResNet, MobileNet, EfficientNet, and a custom-built CNN, in order to identify the optimal model in terms of classification accuracy, efficiency, and computational cost. Key performance criteria like accuracy, precision, recall, inference speed, and computing efficiency will be used to assess these models. Performance will be enhanced by optimization techniques including hyperparameter tweaking and transfer learning.  Finding the lowest dataset size needed for the best accuracy is a crucial part of this research. Training the model on 10%, 20%, 50%, and 100% of the dataset will allow us to track trends in inference speed, training time, and model accuracy. We will identify when adding more data does not yield a discernible improvement in performance if accuracy plateaus after a given dataset size. The time needed to train and forecast at various dataset sizes will also be examined in order to determine the best effective model configuration.  Error analysis will also be performed to find trends in incorrectly labelled photos. We will personally examine challenging samples and group them according to their common problems, including unusual tomato colours, hazy photos, or inadequate lighting. In order to increase classification accuracy, we will add more photographs of underrepresented variations (such as tomatoes with strange colours or blurry images) to the dataset based on these observations. The final model will be reliable and effective for practical food inspection applications thanks to this iterative process. |
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| **5. Timescale (Gantt chart)**  Output image |
| **6. Bibliography/references**  Palakodati, S. S. S., Chirra, V. R. R., Yakobu, D., & Bulla, S. (2020). Fresh and Rotten Fruits Classification Using CNN and Transfer Learning. *Rev. d'Intelligence Artif.*, *34*(5), 617-622.  Hossain, M. A., Ferdous, J., Rahman, M. M., & Hasan, M. (2021). Automated Fruit Ripeness and Spoilage Detection Using Deep Learning Techniques. Computers and Electronics in Agriculture, 190, 106418.  Bhatt, P., Tiwari, A., & Verma, K. (2019). Enhancing Deep Learning-Based Fruit Classification Using Data Augmentation Techniques. Journal of Artificial Intelligence Research, 64, 105-123.  Rahman, M. S., Khan, S., & Alam, M. (2022). Investigating the Impact of Dataset Size on Deep Learning-Based Agricultural Image Classification. Neural Computing and Applications, 34(10), 7531-7543. |