BUBT

Bangladesh University of Business and Technology

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSE)

"Exploring Multiclass Fruits Recognition: A Deep Learning Approch with XAI Insights"

PROJECT PROPOSAL

COURSE CODE : ***CSE 498A***

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Exploring Multiclass Fruits Recognition: A Deep Learning Approch with XAI Insights

MOTIVATION:

Fruit is in great demand by many people, and the classification of fruits is a challenging task because of the different similarity of the fruit. A system can take the traditional way of classifying fruits, but it is time-consuming and results in lower productivity. Fruit is now widely sold in various place, such as supermarkets, markets, malls, and others. However, sometimes it is difficult to distinguish the types of fruit. The classification system helps customers to determine the kind of fruit. Researchers have proposed several methods to build classification models for fruits, the leading technology used in fruit recognition and yield calculation is the intelligent detection system, in which image techniques can be applied, but Most of the literature available right now does not provide enough accuracy for them to be to have practical implementations. So more research is required. Convolutional neural network (CNN) is the most commonly used approach in classification problem. However, they have largely been used as black-box predictors, lacking explanation for the underlying reasons. Explainable artificial intelligence (XAI) is an emerging subfield of AI seeking to understand how models make their decisions. In this work, we will apply XAI visualization to gain an insight into the features learned by our CNN model.

OBJECTIVES:

Most approaches to fruits prediction at the moment has an average accuracy rate of 95%. Our principal objective is to find a method to predict individual fruit that is much more accurate than the methods currently available in relevant literature. Other objectives of ours include –

- Using CNN hybrid models (Including pre-trained models) to find best accuracy .
- Trying Explainable AI (XAI) to insights model predictions & making it more understandable.
- Developed a web interface for the users.

CRITICAL CHALLENGES:

- Developing an effective Convolutional neural network method to bridge the species gap in deep learning models for fruit detection and disease classification.
- Overcoming the limitations of unsupervised learning approaches to reduce the high labeling cost associated with diverse fruit species.
- CNNs are highly complex models with numerous layers and millions of parameters. Interpreting the decisions made by such models becomes challenging due to this complexity.
- Black Box Nature: CNNs are often perceived as "black box" models because they lack transparency in how they arrive at their decisions. Understanding the rationale behind the model's predictions is crucial for trust and accountability, especially in critical applications.
- Feature Attribution: Identifying which features or parts of the input data contribute most to the model's decision-making process is not straightforward in CNNs. Techniques for feature attribution need to be developed to provide meaningful explanations.

CONFLICTING REQUIREMENTS:

Addressing Complex Engineering Problems (Ps) Through This Project –

- *P1: Depth of knowledge required*
  - The project requires knowledge of deep learning and explainable AI (K8)
  - Engineering design and development (K5 & K6)
  - Knowledge of deep learning (K3) and explainable AI (K4)

- *P2: Range of conflicting requirements*
  Huge fruits image data are required, which is very hard to collect or select the proper and perfect data set for classification and training. It is difficult to get more accuracy through tuning the CNN model. XAI is also a challenge to handle.

- *P3: Depth of analysis required*
  Select data set and preprocess the data. Apply CNN models on the data to get predictions and then apply XAI to get the explanation of how the CNN model predicts.

- *P4: Familiarity of issues*
  CNN models are available, no issues to training the data set and get predictions. XAI algorithm is not too much available, so there could be problem while explaining the model.

- *P5: Extent of applicable codes*
  LRP (XAI) method will be used for our CNN model. If it not works then we will use LIME or SHAP method.

- *P6: Extent of stakeholder involvement and conflicting requirements*
  - Kaggle notebook for data set.
  - CampusX youtube chanel for CNN.
  - Git hub code for XAI.

- *P7: Interdependence*
  - Fruit data set selection.
  - CNN model structure and train the data set.
  - LRP (explanation CNN).

Addressing Complex Engineering Activities (As) Through This Project –

- *A1: Range of resources*
  - Image data selection
  - Data augmentation
  - H5 or pickle model saving
  - XAI visualization

- *A3: Innovation*
  - Tuning the CNN model for better accuracy.
  - XAI for CNN model to know how the model predict and why it predict.

- *A5: Familiarity*
  The research deals with image classification and explanation about the deep convolutional networks models.

Dataset Link: https://www.kaggle.com/datasets/moltean/fruits