INFO8010: Project proposal

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I. SECTION 1: PROJECT DESCRIPTION

Crop diseases pose a major threat to food security, yet their rapid identification remains challenging in many regions of the world due to a lack of necessary infrastructure. The widespread penetration of smartphones globally, coupled with recent advancements in computer vision made possible by deep learning, has paved the way for smartphone-assisted diagnosis of crop diseases. The aim of this project is to build a deep neural network capable of analyzing images captured by smartphones to quickly and accurately identify crop diseases.

II. SECTION 2: DATA

We are analyzing 54,306 images of plant leaves, which are categorized into 38 class labels. Each class label corresponds to a crop-disease pair, and our goal is to predict this pair from the image of the plant leaf. These images are sourced from the dataset available at the following repository: `https://github.com/digitalepidemiologylab/plantvillage_deeplearning_paper_dataset`. To train our AI-based image recognition system, we will utilize this dataset.

In all our experiments, we utilize three different versions of the PlantVillage dataset. We begin with the original dataset in color, then we explore a grayscale version, and finally, we conduct our experiments on a version where the leaves are segmented. This approach allows us to assess the performance and robustness of our image recognition system in various contexts. We analyze how variations such as color, grayscale, and leaf segmentation can impact the model's results. By understanding how our system behaves under these different conditions, we can better evaluate its ability to generalize and operate effectively in real-world environments. These three versions of the data are already available via the above-mentioned link.

III. SECTION 3: COMPUTING RESOURCES

If possible, we require access to powerful computers with GPU capabilities to train our deep convolutional neural network, as we have a large number of images to process.

IV. SECTION 4: NEURAL NETWORK ARCHITECTURE

For our convolutional neural network architecture, we draw inspiration from the pioneering AlexNet model proposed by Krizhevsky et al. in 2012 which has been applied for image-based plant desease detection[1]. AlexNet comprises five convolutional layers followed by three fully connected layers. The architecture includes max-pooling layers and employs the ReLU activation function to introduce non-linearity. Dropout layers might be also incorporated to prevent overfitting. Batch normalization is another key component introduced in AlexNet to accelerate the training process.

We plan to adapt and modify the AlexNet architecture to suit our specific task of crop disease identification. While the original AlexNet was designed for the ImageNet dataset, which consists of a thousand different classes, we will adjust the output layer to accommodate our classification task, which involves predicting the crop-disease pair from input images of plant leaves.

Our modified architecture will retain the fundamental principles of AlexNet, including its convolutional and fully connected layers, activation functions, and regularization techniques. However, we will fine-tune the hyperparameters and possibly introduce additional layers or modifications to optimize performance for our specific dataset and task.

By leveraging the proven architecture of AlexNet and customizing it for our crop disease identification task, we aim to develop a deep neural network capable of accurately classifying plant leaf images and facilitating rapid diagnosis of crop diseases using smartphone technology.

[1] Sharada P Mohanty, David P Hughes, and Marcel Salathé. Using deep learning for image-based plant disease detection. *Frontiers in plant science*, 7:215232, 2016.