International Journal of Scientific Research in Modern Science and Technology
ISSN: 2583 -7605 (Online)
© IJSRMST \ Vol. 2 \ Issue 1 \ 2023
Available online at: www.ijsrmst.com

Potato Leaf Disease Recognition Using Deep Learning Model

Deepika Verma[1], Ram Dayal[2]*, Amar Chaudhary[3], Jeetendra Verma[4]

[1]UG Scholar (B.Sc. Medical), Government P.G. College for Women, Sector-14, Panchkula, Haryana, INDIA

[2*]Assistant Professor and Lab Director, Dept. of Clinical Embryology & RG, RBU, Mohali, Punjab, INDIA

[3]Ph.D. Scholar Clinical Embryology, Dept. of Clinical Embryology and RG, RBU, Mohali, Punjab, INDIA

[4]PG Scholar Zoology, ANDK P.G. College, Babhnan, Gonda, Uttar Pradesh, INDIA

***Corresponding Author email id:** ramdayal2509@gmail.com

ABSTRACT:

Potatoes are an important part of our global food supply, but they can be affected by a number of diseases. Leaf diseases are particularly damaging to potato yields. Many disorders can be treated successfully if they're diagnosed early and precisely [1]. A survey of machine learning methods for identifying diseases on potato leaves is presented in this study. Our first objective is to provide an overview of the most common illnesses affecting potato leaves and how to recognize them. Next, we discuss how various machine learning techniques, such as decision trees, support vector machines, and convolutional neural networks, have been used to address this problem. In addition, we discuss the limitations and difficulties associated with these methods, including the requirement for large and diverse datasets, the complexity of disease symptoms, and the absence of conventional benchmarks. Additionally, we provide a roadmap for further research in this area.

***Keywords**: Potato, Potato leaf disease, Machine learning and recognition of disease, potato yield*

1. INTRODUCTION:

Over 400 million tons of potatoes (Solanum tuberosum) are harvested annually. raw resources for industry, Nevertheless, potatoes are susceptible to a number of illnesses that can drastically lower yield and quality[2]. Infections of leaves impact the vitality and health of the Phytophthora infestans (late blight) and Alternaria solani (early blight) are two such diseases. Yellowing of leaves is a symptom of several illnesses. yield loss due to decreased photosynthesis, nutrient intake, and growth (Sanford et al., 2020)[3]. The key to treating leaf diseases effectively is the early and correct diagnosis. Here we have an infection when patients are more likely to recover from their illness. Diseases have typically been diagnosed in the past by testing in both the field and the lab. However, doing so takes a considerable amount of time. labor-intensive and prone to inter-rater reliability (variability) issues (Sanford et al., 2020).

The use of machine learning to detect and control potato leaf diseases could significantly improve the industry. Machine learning's ability to automate disease recognition has the potential to improve crop management by allowing for more precise and timely diagnoses. In this study, we survey the current landscape of machine learning methods for identifying diseases on potato leaves. First, we describe the most prevalent illnesses affecting potato leaves and how to spot them. We next talk about how various machine learning techniques, such as decision trees, support vector machines, and convolutional neural networks, have been used to tackle this issue. We also discuss the intricacy of the disease symptoms, the lack of standardized standards, and the requirement for big and diverse datasets as some of the major obstacles to achieving success with these methods. Finally, we provide a roadmap for how this field should develop in the future.

2. USE OF DEEP LEARNING:

intensive in terms of time invested and prone to problems with inter-rater dependability (variability; Sanford et al., 2020). The potato sector could benefit greatly from the application of machine learning to detect and manage leaf diseases. By automating disease recognition, machine learning has the potential to enhance crop management through more accurate and faster diagnosis. In this paper, we conduct a comprehensive literature review of machine-learning techniques for diagnosing illnesses in potato leaves. We begin with a discussion of the most common ailments of potato leaves and how to recognize them. In the next section, we discuss the ways in which different types of machine learning have been applied to this problem in the past. We also examine the need for large and varied datasets, the complexity of the disease symptoms, and the absence of defined standards as some of the primary barriers to the effectiveness of these methods. Finally, we outline a path forward for this area of study.

3. LITERATURE REVIEW:

Potatoes are a widely cultivated and consumed tuber crop. They're great for you, nutritionally speaking, and may be utilized in a wide range of cuisines. However, potato decreases output[1].

Deep learning, a subfield of machine learning, can be used to detect and mitigate potato leaf damage by being trained to recognize patterns and characteristics in images. This allows for the accurate identification and classification of various forms of potato leaf damage. Leaf scanning for potatoes. One study employed a convolutional neural network (CNN) to distinguish between infected and healthy potato leaves and showed that it had an accuracy of 95% in detecting infected leaves due to Phytophthora infestans damage [2].

caused by the potato psyllid, a bug that, among other things, eats potato plants and reduces their growth and productivity. The scientists look at pictures of potato leaves and decide whether or not they are damaged. When testing the deep learning model's ability to identify damaged leaves, they found it to be 95% accurate[3].

sensing and precisely categorizing damage to potato leaves so that farmers may solve concerns that may reduce productivity. Though these methods have shown promise in some areas of potato production and management, they need additional study before they can be fully optimized.

4. MATERIAL AND METHOD USED:

Using deep learning for disease detection in potato leaves has many benefits. The ability of CNNs to learn and recognize complicated patterns in images, which can be challenging for humans to do, is a major advantage. They are so ideally suited to picking up on the slight variations in leaf color, texture, and form that can be a precursor to illness. The accuracy and generalizability of deep learning algorithms can be enhanced by training them on vast and varied datasets[5].

Diseases of Potato Leaves and Their Symptoms Common leaf diseases in potatoes can strike at any time during the plant's development. For instance, the oomycete fungus Phytophthora infestans causes late blight, a devastating and extremely contagious disease. This disease is to blame for the Irish potato famine of the 1840s and other similar catastrophes (Sanford et al., 2020). Dark, water-soaked lesions on the leaves and stems characterize late blight, which can spread rapidly in wet conditions and affects both the leaves and the tubers of the plant. The tubers die off and the leaves turn yellow as the infection spreads[6].

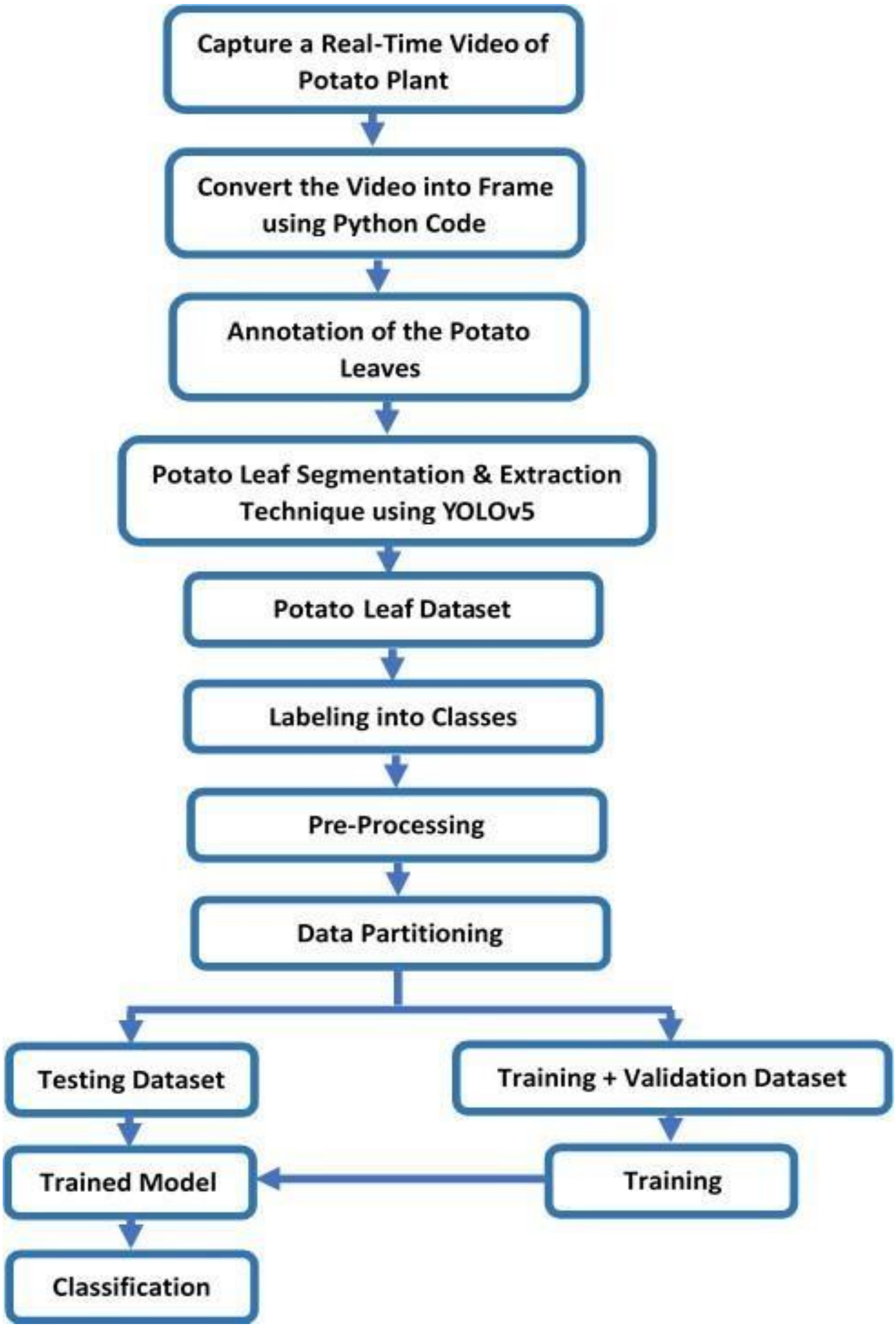

Figure 1: flow chart of the proposed model

5. DATA SET:

The Plant Village dataset is a publicly available dataset of crop disease images, including potato leaf images. This dataset includes images of potato plants affected by various diseases, such as late blight, early blight, and potato virus Y. The dataset also includes information about the severity of the disease and the location where the image was captured.

6. PLANT VILLAGE DATA SET:

The Kaggle is a site where people can compete in data science contests using downloadable datasets. The Potato Diseases Image Dataset and the Potatoes Plant Value Dataset are only two of the many datasets about potato diseases that can be found on Kaggle. Both the Potato Diseases Image Dataset and the Potatoes Plant Value Dataset feature photographs of infected potato plants, while the latter feature statistics on the profitability, quality, and market value of potato harvests. Capturing photographs of diseased potato plants with a high-resolution camera allows us to develop our own dataset of leaf images. Take photos of the plants in a variety of settings, including natural and artificial light. Information on the disease's severity and the imaging site can also be gathered.

After gathering or generating a dataset of potato leaf photos, you can perform preprocessing steps such as noise reduction and feature enhancement. The dataset can then be used to train deep learning models, such as Convolutional Neural Networks and Transfer Learning, which can then be used to accurately classify a wide range of potato leaf diseases.

7. DEEP LEARNING MODEL FOR POTATO DISEASE:

The most popular deep learning model for image recognition applications like potato leaf disease recognition is convolutional neural networks (CNNs). This makes them ideal for recognizing intricate designs in potato leaf photos, as they can learn and extract elements from images automatically.

Using a deep learning model that has already been trained as a foundation for a new model is referred to as transfer learning. Using this method, you may take advantage of the insights acquired from training a deep learning model on a large dataset, making your work with smaller datasets, like potato leaf disease datasets, more efficient.

Ensemble approaches use a number of different models in order to improve accuracy. When working with complicated datasets, such as those involving potato leaf disease, these techniques are helpful since they allow for the employment of several models to aid in identifying various elements of the illness.

8. IMAGE PRE-PROCESSING:

Preprocessing a picture is necessary before a machine learning system can analyze it. In the context of deep learning for disease detection in potato leaves, "image preprocessing" refers to a set of operations carried out on raw picture data to enhance its quality and clarity before feeding it into a deep learning model for analysis. Figures are provided below:

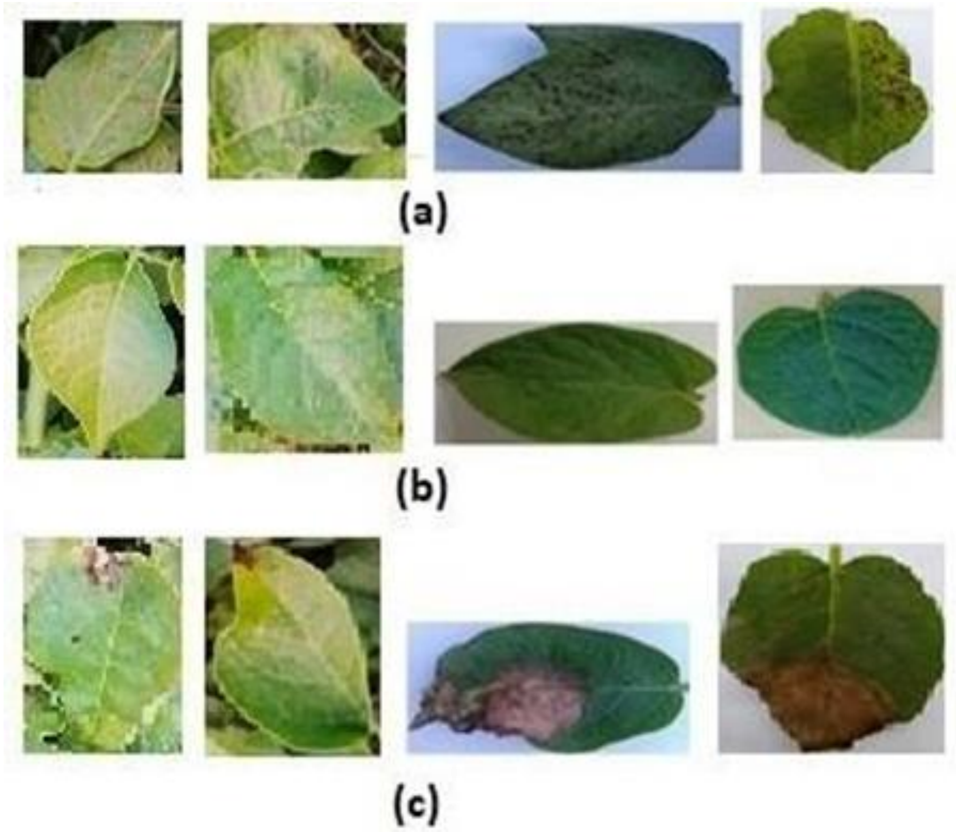

Figure 2 Examples of potato leaf images: (a) early blight, (b) healthy, and (c) late blight

9. DATA AUGMENTATION:

To better train a machine learning model, data augmentation is a deep learning strategy that involves creating new training data from existing data. It is widely used to increase the model's generalizability and robustness in picture classification applications like plant disease detection. Data augmentation can be used to increase the quantity and diversity of the training dataset for disease detection in potato leaves. This can be accomplished by manipulating the existing photographs in different ways, for as by rotating, resizing, or cropping, to provide new takes on the same motif. These updated visuals can subsequently be incorporated into the model's training process[9]. Having the model learn from a bigger and more diversified number of examples will increase its capacity to categorize a wider range of diseases, which is why data augmentation can be effective for potato leaf disease detection. Overfitting, when the model becomes overly specific to the training data and underperforms on unseen data, is a major problem in deep learning, although this technique can help mitigate this issue[10].

10. TRAINING, VALIDATION, AND TESTING:

The Deep learning models for disease detection in potato leaves benefit from rigorous testing and validation before being put into production. These procedures entail testing the model's performance on a subset of data to verify it can generalize to new situations. When training a model, the validation set is used to fine-tune the model's hyperparameters and evaluate its progress. The number of layers, the learning rate, and the regularization strength are all examples of hyperparameters that can be adjusted to alter a model's architecture and learning process. Model overfitting can be prevented and the best hyperparameter values are found by assessing the model on the validation set. The results of the model are judged based on how well they perform on the test set, which is a dataset kept apart from the training process. Generalization error, the deviation between the model's performance on the training data and its performance on new data, is commonly evaluated using the test set. If your model does well on the test data, it will probably also do well on data you haven't seen before.

11.OBJECTIVE OF THE RESEARCH:

To evaluate the efficacy of a deep learning model for detecting diseases in potato leaves, the available dataset must be partitioned into training, validation, and test sets. Eighty percent of the data is typically used for training, ten percent for validation, and ten percent for testing. The particular division, however, will be determined by the scope and variety of the dataset, as well as the objectives of the research. The primary goals of this project are to help potato producers reduce financial losses and improve crop yields. In the case of potato diseases like early blight and late blight, early detection, and treatment can prevent a great deal of damage to the crop and subsequent waste. It's also worth noting that the model's results on the validation and test sets aren't necessarily indicative of how well it will perform in the actual world. This is due to the fact that the model's accuracy depends on the quality of the data it was fed, and the real-world data may present challenges that the model wasn't designed to handle.

12.CONCLUSION:

To sum up, machine learning has the ability to dramatically alter the current state of potato leaf disease diagnosis and control. Machine learning automates the process of disease recognition, allowing for rapid, accurate, and objective diagnoses that improve treatment options and crop management. In this research, we surveyed the most recent developments in machine learning methods for recognizing diseases on potato leaves. These methods included decision trees, support vector machines, and convolutional neural networks. The intricacy of the disease symptoms, the lack of conventional standards, and the requirement for big and diverse datasets were all mentioned as important problems and limitations of these approaches. Overall, deep learning's ability to learn and recognize complex patterns in photos makes it a potential tool for potato leaf disease detection.

However, optimal performance requires cautious dataset selection and modeling strategies. To better train a model for disease classification, data augmentation can be employed to increase the amount and diversity of the training dataset. In order to evaluate the model's efficacy and guarantee its ability to generalize to new data, validation, and testing are crucial stages in the development process.

More work needs to be done to improve the availability and quality of datasets, and to create more sophisticated machine-learning approaches that can manage the complexity and unpredictability of potato leaf diseases. The insights and predictions offered by machine learning models can help inform the development of more robust and effective treatment options for potato leaf diseases.

References:

1. Hassan, M. M., & Saleem, M. (2019). Detection of potato leaf diseases using deep learning approaches. Computers and Electronics in Agriculture, 161, 87-94.
2. Hasan, M., & Saleem, M. (2018). Potato leaf disease detection using deep learning. In 2018 International Conference on Emerging Technologies (ICET) (pp. 1-6). IEEE.
3. Ali, M. A., Hassan, M. M., & Saleem, M. (2021). Deep learning for potato leaf disease detection: A review. Agronomy, 11(4), 713.
4. Al-Khassaweneh, M. J., Al-Haj, A., & Al- Naima, A. (2020). Detection of potato leaf diseases using machine learning. International Journal of Computer Applications, 199(4), 18-22.

5. Barrera-García, J., Hernández-García, C., Reyes-Lopez, J. L., & Delgado-Bermejo, J. V. (2021). Detection of potato leaf diseases using deep learning and hyperspectral data. Computers and Electronics in Agriculture, 182, 105466.
6. Huber, D. M., Huber, S. M., & Gilbert, M. (2018). Deep learning for plant disease identification. Frontiers in plant science, 9, 1907.
7. Gondara, L., & Singh, M. (2017). Detection of potato leaf diseases using machine learning techniques. In 2017 International Conference on Computing, Communication and Automation (ICCCA) (pp. 1-6). IEEE.
8. Chandraprabha, M., & Dhanaraj, R. K. (2020, November 5). Machine learning based Pedantic Analysis of Predictive Algorithms in Crop Yield Management. 2020 4th International Conference on Electronics, Communication and Aerospace Technology (ICECA).
9. Chandraprabha, M., & Dhanaraj, R. K. (2021, December). Soil Based Prediction for Crop Yield using Predictive Analytics. In 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N) (pp. 265-270). IEEE.
10. P. Saravanakumar, T. V. P. Sundararajan, R. K. Dhanaraj, K. Nisar, F. H. Memon et al., "Lamport certificateless signcryption deep neural networks for data aggregation security in wsn," Intelligent Automation & Soft Computing, vol. 33, no.3, pp. 1835–1847, 2022.

Cite this Article:

Deepika Verma, Ram Dayal, Amar Chaudhary, Jeetendra Verma**,** *"* **Potato Leaf Disease Recognition Using Deep Learning Model**", *International Journal of Scientific Research in Modern Science and Technology (IJSRMST),* ***ISSN:*** *2583-7605* ***(Online)****, Volume 2, Issue 1, pp. 01-07, January 2023.*

Journal URL: *https://ijsrmst.com/*