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CROP AND WEED CLASSIFICATION USING MODIFIED CONVOLUTIONAL NETWORK

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ABSTRACT- Internet of things (IoT) in the horticulture field gives crops-arranged data sharing and programmed cultivating arrangements under single organization inclusion. The segments of IoT gather the recognizable data from various plants at various points. The data accumulated through IoT parts, for example, sensors and cameras can be utilized to be controlled for a superior cultivating focused dynamic cycle. The irksome technique for distinguishing sicknesses like rust, spots, and creepy crawly pervasion caused numerous misfortunes for farmers because of inappropriate determination and therapy. This examination plans to apply deep learning strategies to ease the issue. Legitimate tuning of hyper parameters can address overfitting along with a proper decision of analyzers bringing about a productive classifier. Additionally, this examination recognized potential future exploration attempts to apply the model for genuine situations. Weed location and classification are significant and pivotal strides for region explicit weed control. This diminishes the general expense and the adverse consequence of utilizing pointless herbicides on human health and crops.

Keywords: [weed, classification, convolutional network, crop, ensemble learning.]

1. INTRODUCTION

The programmed recognizable proof and conclusion of tomato leaves sicknesses are exceptionally wanted in the field of farming data. As of late Deep Convolutional Neural organizations (CNN) has made gigantic advances in numerous fields, near PC vision like classification, object detection, division, accomplishing preferable exactness over human-level insight. Regardless of its gigantic advances in PC vision errands, CNN faces numerous difficulties, like computational weight and energy, to be utilized in cell phones and implanted frameworks. In this examination, we propose a proficient shrewd versatile application model dependent on deep CNN to perceive tomato leaf illnesses.

All current leaf plant infections detection strategies depend on the utilization of PCs with the force of calculation. One disadvantage of these strategies can't be utilized in Mobile and inserted frameworks with least assets of calculation. Albeit the quantity of investigates made in this field, all keen frameworks that have been worked to distinguish plant infections, in view of the new deep CNN, are generally restricted to the utilization on the PC with a huge stockpiling limit and assets computation.

The fruitful Deep Learning approach served various types of visual assignments, including picture acknowledgment, classification, and detection. The utilization of a little part or channel permits the extraction of various highlights from a picture going from low to an undeniable level arrangement of subtleties. The underlying learning stage perceives the edges, bends, masses, and other significant data. The regulated methodology of having a multi-stage preparing measure made huge commitments to PC vision viewpoints lately. Deep learning models like CNN have indispensable boundaries that can have an effect in how the result would be. Hyper parameters help the deep learning model to deliver huge outcomes even before the genuine preparing technique happens.

RS data have been extensively utilized in farming since it's anything but a savvy way for observing enormous regions and anticipating crop yield. In any case, this undertaking is as yet testing since it relies upon a few occasional components. The new accessibility of free symbolism with high spatial goal and low return to time additionally expanded the plausibility of planning crops from groupings of RS pictures. Also, the accessibility of high-goal Synthetic Aperture Radar (SAR) satellites, similar to Sentinel 1-A, reduces issues identified with optical pictures, for example, overcast cover and atmospheric conditions. A key issue in RS picture classification identifies with catching context oriented information. In crop planning, the worldly setting is much more basic than the spatial one, in light of the fact that most harvest types must be segregated by misusing their trademark fleeting conduct. In tropical districts, this errand is especially difficult. The CNN-PC design takes as info a picture fix and predicts the mark of its focal pixel. As represented in Fig. 1, it's anything but a convolution layer followed by two down sampling layers. Then, at that point, they are trailed by a completely associated layer and an initiation layer, which relegates class scores to the focal pixel of the information fix. Like, each down sampling is carried out as a thick square followed by a convolution and a maximum pooling layer. Each thick square is made out of two convolutional steps, whereby the contribution of a square is linked with its yield.

Weed detection and classification are significant and critical strides for region explicit weed control. This lessens the general expense and the adverse consequence of utilizing pointless herbicides on human health and crops. As the ghostly likeness among weeds and crops is high, fix based classification approaches are received in this letter. Convolutional neural network (CNN) and histogram of arranged slopes (HoG) strategies are assessed and thought about. With the headway in distant detecting advances, an enormous number of sensors are accessible which furnish various groups with various spatial goals. The impact of this minor departure from weed recognizable proof is researched. Test results show that the CNN technique separates more discriminative and incredible highlights that lead to precise classification of various weeds contrasted with the HoG strategy. Examination of the two significant boundaries gives direction in picking the right fix size, spatial goal, and the quantity of groups to utilize when CNN is applied for precise and productive weed classification.

Weeds fill in the fields alongside crops bringing down the harvest yield with 30% more misfortunes. Effective utilization of synthetic herbicides can repress the development of weeds, yet to do that we need the area of weeds to be known. Flying pictures given by robots can be utilized as a securing framework for ongoing weed detection. Machine learning algorithms are as yet confronting automatic detection challenges.

Region explicit weed control utilizing hyperspectral pictures is an arising field in the space of far off detecting. As the data are currently assembled from various sensors for the weed classification, select the right subsets of groups, the suitable fix sizes with a given spatial resolution, in applying the CNN technique.

Image acquisition and sampling

Most pictures were gotten through fields physically utilizing a cell phone camera for the contaminated harvest locales as noticeable from the manual examination. For the training motivation behind the framework, a few pictures were altered to work on the dataset without influencing the detection algorithm. The information unique pictures were taken in an adequate brilliance environment and natural environment

Data and preprocessing

The preprocessing cycle of SAR information incorporates: Firstly, multi-see handling is performed to lessen the degree of speckle noise, which is useful to distinguish more spatial distribution features and highlight data. From that point onward, the Refine Lee channel is applied by choosing a 5×5 window size, which brings about a smooth picture without speckle noise.

Using Convolution Neural Network

CNN is among the created picture classification algorithm which comprises of series of convolution layers with channels (Kernels), pooling, completely associated layers (FC) and afterward utilizes softmax function to classify an article.

2. LITERATURE SURVEY

1. V. E. Neagoe and P. Diaconescu (2020) et.al proposed An Ensemble of Deep Convolutional Neural Networks for Drunkenness Detection Using Thermal Infrared Facial Imagery. Drunkenness is a moving physiological condition to be explored with applications to test pilot condition. Tipsy driving is frequently a manifestation of liquor issues as well as of others as medication, joblessness, legitimate status and psychosocial issues. This paper proposes a unique method for subject autonomous drunkenness detection utilizing an ensemble of Deep Convolutional Neural Networks (DCNNs) for processing of warm infrared facial imagery portraying the subjects to be tried. The proposed neural system comprises of an ensemble of two DCNNs modules for warm infrared facial image processing; the principal module is formed by 12 layers and the subsequent one has 10 layers. The two DCNNs have been prepared independently, utilizing various structures and various arrangements of parameters. An official conclusion is impacted by the certainty levels of two CNN part modules. The introduced method of subject autonomous drunkenness conclusion addresses an astonishing mix of present day technology strategies: warm infrared image processing and deep learning based on CNNs. One primary oddity of the method is that the proposed neural system is made by an ensemble out of DCNNs prepared to handle the information warm facial images. The advantages of the system based on the ensemble of two DCNNs over a solitary DCNN module are the accompanying: (a) superior drunkenness detection execution: 2.5% more contrasted and the instance of utilizing a solitary DCNN (b) seriously preparing environment adaptability given by the reality the DCNNs from the ensemble can be arrived behind schedule on various equipment for the whole preparing stage. The in general right intoxication detection execution of 95.75% affirms the viability of the proposed approach by comparison with the best in class methods. Additionally, the introduced DCNN system enjoys the conspicuous benefit that it performs both element determination and classification, hence staying away from the need to utilize old bulky and time-devouring methods for includes choice.

Merits

Performs both feature selection and classification, thus avoiding the necessity to use old cumbersome and time-consuming techniques for feature selection.

Demerits

The world populations are showing drunk driving along with speeding and failing.

2. M. A. Dede, E. Aptoula and Y. Genc (2019) et.al proposed Deep Network Ensembles for Aerial Scene Classification. The joined multiplication of both automated flying vehicle innovations and of high goal

visual sensors as of late has prompted the quick development of elevated scene data stores and expanded the interest for powerful, proficient just as adaptable answers for their misuse and the executives. The classification of ethereal scenes is of central significance in this specific circumstance, as it's anything but a critical job in numerous significant applications; e.g., urbanization and environmental monitoring, fiasco the board, and traffic supervision. It is notable in the machine instructing local area that the ensembles of neural networks beat the particular individual networks; thus late work on ethereal scene classification has been moving toward different network combination techniques. This letter has zeroed in on aeronautical scene classification through deep network ensembles, and especially on the as of late presented computationally proficient snapshot learning procedure. In particular, we have investigated three ensembling, methodologies; snapshot, homogeneous and heterogeneous, through the link of the last convolutional layers' outputs and a multi-facet Perceptron classifier. They have been carried out with two unmistakable and contemporary models, one of which has been applied in this setting interestingly, and tried with the two biggest and most testing data sets accessible, where critical additions w.r.t. the best in class have been accomplished. Future work will zero in on investigating elective model mix techniques that can misuse the spatial course of action of the consolidated component maps just as the variation of these procedures to multi- and hyper-spectral data sets.

Merits

The two largest and most challenging data sets available, where significant gains w.r.t. the state of the art have been achieved.

Demerits

The spatial arrangement of the combined feature maps are not adapting of these strategies to multi- and hyper-spectral data sets.

3. S. Yang, L. Chen, T. Yan, Y. Zhao and Y. Fan (2017) et.al proposed an ensemble classification algorithm for convolutional neural network based on AdaBoost. As a fundamental issue in machine learning, classification issue encountered a significant stretch of innovative work, created a ton of arrangements like KNN (k-Nearest Neighbor), Decision Tree, and Naive Bayesian. This paper plan an ensemble network classifier named ACNN that have new class weight task method and preparing method. ACNN can successfully decrease the classification blunder rate. Moreover, this paper examines the most sensible number of base classifiers which establish ACNN. As indicated by the presentation of ACNN on MNIST with 2, 3, 4, 6, 8, and 10 base CNN classifiers, reach resolution that the most appropriate number is 4 or 6 consolidating blunder rate and preparing time. Furthermore, this paper plans another weight task method makes preparing keep an eye on those classes that have higher blunder rate, this inclination creates ACNN can take care of the issue of the class recognition rate imbalanced partially and demonstrates it in tests. This paper likewise has a few issues, one is because of the gigantic computational intricacy of CNN and breaking point of PC execution (which is the main factor once ruined the advancement of CNN). We pick a few straightforward datasets, the size of test (image) is 32 * 32 pixels, and the quantity of class is 8 or 10. CNN goodly affects them, so advancement by ACNN isn't self-evident. Second, in this paper, the motivation behind ACNN is to lessen the classification mistake rate, not explicitly the class recognition rate imbalanced issue. In spite of the fact that ACNN can accomplish a more adjusted outcome, yet it's anything but suggested as the fundamental arrangement, since it's preparation time is a lot bigger than a solitary CNN.

Merits

ACNN is to reduce the classification error rate, not specifically the class recognition rate imbalanced problem.

Demerits

The huge computational complexity of CNN and limit of personal computer performance.

4. S. A. Riaz, S. Naz and I. Razzak (2020) et.al proposed Multipath Deep Shallow Convolutional Networks for Large Scale Plant Species Identification in Wild Image. Plants are one of the significant backbones to help human life, however practically all life on Earth. Current appraisals of blooming plant species are around 420,000. Notwithstanding, 20% of plants on Earth are defenseless against basically jeopardized by the International Union for Conservation Nature (ICUN) Red List data. Agriculture researcher dissect plants to describe into various species, in any case, sorting plants into various boorish based on visual appearance is testing and requires ability, in this manner practically difficult to personality for normal public. Given a normal of 20,000 word jargon of local English speaker, in any event, educating and learning the "charge on jargon" of plant is a drawn out try. Hence, ordered information on plant species and their identification abilities are confined, in this manner, restricted to number of people today. Taxonomists are searching for proficient methods to meet identification prerequisites. As of late, cutting edge Deep Convolutional Neural Networks are calibrated to order various types of plants notwithstanding, it actually endure because of the intricacy of the plant images. In this paper, we present created shallow deep convolutional network for the identification of plant species which takes care of various adaptations of plant images, consequently resultant model has preferred image show over conventional CNN. Our shallow network showed impressively better execution when contrasted with pretrained deep learning models of AlexNet, GoogLeNet, and VGGNet. What's more, number of parameters is a lot more modest than pretrained network. Far reaching exploratory assessment on benchmark dataset showed that proposed network beat cutting edge work with generally speaking exactness of 99.38% and 99.22% for Leafsnap and MalayaKew datasets individually. We found that joining different image points of view portraying a similar plant builds the unwavering quality of recognizing its species. We notice that precision is influenced because of normal event of comparable leaf forms, particularly in firmly related species, which could be improved including extra leaf highlights.

Merits

Combining multiple image perspectives depicting the same plant increases the reliability of identifying its species.

Demerits

That accuracy is affected due to common occurrence of similar leaf contours, especially in closely related species.

5. A. Simonelli, F. De Natale, S. Messelodi and S. R. Bulo (2018) et.al proposed Progressively Specialized Ensemble of Convolutional Neural Networks for Fine-Grained Recognition. Fine-grained recognition centers on the difficult undertaking of consequently distinguishing the unobtrusive contrasts between comparative classifications. Present status of-the-workmanship approaches require explained include learning methodology, involving tuning several hyper-parameters, or depend on expensive human comments, for example, items or parts area. In this paper we propose a basic method for fine-grained recognition that misuses an almost sans cost consideration based center activity to build an ensemble of progressively specialized Convolutional Neural Networks. We proposed a straightforward method that misuses an almost sans cost consideration based center activity to develop an ensemble of progressively specialized CNNs. Our method builds up another state-of-the-craftsmanship score on three of the most famous datasets utilized for fine-grained classification requiring insignificant hyper-boundary tuning and no comments. Future work will be equipped towards the development of an intermittent method which avoids having free neural networks,

in this way extensively diminishing the overall measure of parameters, just as towards the investigation of other restriction strategies, which can be learned alongside classification without compromising the overall effortlessness of the preparation methodology.

Merits

State-of-the-art score on three of the most popular datasets used for fine-grained classification requiring minimal hyper-parameter tuning and no annotations.

Demerits

The development of a recurrent method which avoids having independent neural networks, thus considerably reducing the overall amount of parameter.

3. ALGORITHMS FOR CROP AND WEED CLASSICATION USING MODIFIED CONVOLUTIONAL NETWORK

Self-organizing maps are a class of unaided learning neural networks utilized for highlight location. They're utilized to deliver a low-measurement space of preparing tests. Accordingly, they're utilized for dimensionality decrease.

SOMs vary from other artificial neural networks since they apply serious learning rather than blunder corresponded realizing, which includes Back propagation and angle plunge. In aggressive learning, nodes seek the option to react to the information data subset. The preparation data as a rule has no names and the guide figures out how to separate and distinguish features dependent on likenesses.

SOM Algorithm Basic Steps

Step 1: Initialize map
Step 2: For t from 0 to 1
Step 3: Randomly select a sample
Step 4: Get best matching unit
Step 5:Scale neighbours
Step 6: Increase 't' a small amount
Step 7: End for

Deep Belief Networks (DBNs) were developed as a solution for the issues experienced when utilizing conventional neural networks preparing in deep layered networks, like lethargic learning, getting stuck in neighborhood minima because of helpless boundary determination, and requiring a ton of preparing datasets. Deep belief networks are pretrained by utilizing an algorithm called the Greedy algorithm. This algorithm utilizes a layer-by-layer approach for learning every one of the hierarchical methodologies and most significant generative loads. These related loads determine how all variables in a single layer rely upon different variables in the above layer. In DBN, we execute a few stages of Gibbs sampling on the best two secret layers. This stage is essentially drawing an example from the RBM by the two secret layers at the top.

Algorithm: Deep Belief Network Algorithm

Input: RBM(v,h), training batch B
Output: approximate gradient $\Delta w, \Delta a, \Delta b$
Step 1: init $\Delta w_{ij} = \Delta a_i = \Delta b_j = 0$ for I =1,…., n, j=1,….,m
Step 2: for all the sample $\in$ **B** do
Step 3: $v^0 \leftarrow$ sample
Step 4: for t =0 ,….,k -1 do
Step 5: for j=1,…,m do sample $h_j^{(t)}$ from $p(h_j|v^{(t)})$
Step 6: for i=1,…,n do sample $v^{(t+1)}$ from $p(v_i|h^{(t)})$
Step 7: Sample $h_j^{(k)}$ from $p(h_j|v^{(k)})$ for j = 1,…,m
Step 8: for i= 1,….,n, j=1,….,m do
Step 9: $\Delta w_{ij} \leftarrow \Delta w_{ij} + v_i^{(0)} . h_j^{(0)} - v_i^{(k)} . h_j^{(k)}$
Step 10: $\Delta a_i \leftarrow \Delta a_i + v_i^{(0)} - v_i^{(k)}$
Step 11: $\Delta b_j \leftarrow \Delta b_j + h_j^{(0)} - h_j^{(k)}$

Deep Learning has end up being an amazing asset in light of its capacity to deal with a lot of information. The interest to utilize covered up layers has outperformed traditional techniques, particularly in design recognition. Quite possibly the most famous deep neural organizations is Convolutional Neural Networks. In deep learning, a convolutional neural organization (CNN/ConvNet) is a class of deep neural organizations, most generally applied to investigate visual symbolism. Presently when we think about a neural organization we consider network multiplications yet that isn't the situation with ConvNet. It's anything but an exceptional strategy called Convolution. Presently in mathematics convolution is a numerical procedure on two functions that delivers a third capacity that expresses how the state of one is altered by the other.

Convolution Neural Network Algorithm

Input: Training set $D_{train} = [(x_i, y_i)]_{i=1}^{N_{Train}}$
Output: Parameters of the theorem bedding function f_{op}
Step 1: For I in $\{1, N_{Train}\}$do
Step 2: search the N_P patches $\{P_{i,m}\}_{m=1}^{N_p} \leftarrow x_t$
Step 3: For patch p in $\{P_{i,m}\}_{m=1}^{N_p}$ do
Step 4: Search the triplet patches: $(P_1, P_2, P_3,) \leftarrow P$
Step 5: Compute triplet features: $f_\varphi(p_1), f_\varphi p_2)) \leftarrow (p_1, p_2)$
Step 6: back propagation
Step 7: end for
Step 8: end for

3.1 Comparison of Self-organizing maps, Deep Belief Networks and Convolution Neural Network Algorithm

Input

The input information was a table with a line for every individual from Congress, and columns for specific votes containing every individual. A DBN can figure out how to probabilistically remake its inputs. Convolutional Neural Networks exploit the way that the input comprises of pictures and they compel the architecture in a more sensible manner.

Best suitable for

This works best on a reduction algorithm for the most part used to address a high-dimensional dataset as a two-dimensional defamed design. Deep-conviction networks are utilized to perceive, group and produce pictures, video sequences and movement catch data. The fundamental benefit of CNN contrasted with its archetypes is that it naturally distinguishes the significant features with no human supervision.

Data

Self-Organizing Maps (SOMs) are a type of solo neural network that is utilized for visualization and exploratory data examination of high dimensional datasets. A deep belief network (DBN) is a generative graphical model, or then again a class of deep neural networks, made out of various layers of idle factors. Convolutional neural network, or CNN for short, is a particular sort of neural network model intended for working with two-dimensional image data.

Recurrent Connections

There are intermittent connections. RNN has repetitive connections. The network is like the CRNN however creates better or ideal outcomes, particularly towards sound sign processing.

Parameter sharing

Self-Organized Map, a novel variation of the notable ... of the models and will influence the assessment of parameters. Parameter sharing or loads replication is a point region that can be overlooked within

Deep learning examines. All units within this layer plane offer similar loads; subsequently it is called weight/parameter sharing.

CONCLUSION

Deep convolution neural network have accomplished extraordinary execution leap forwards in machine learning fields, however there still exist some exploration challenges. The proposed CNN based model can adequately order 10 normal tomato leaves sicknesses through picture recognition. We can broaden the model for flaw conclusion. The use of deep CNN created important outcomes to contribute to the developing issue looked in present day espresso cultivating ventures. Another significant strategy for diagnosing Barako leaf illnesses would now be able to help ranchers and farmlands to protect a greater amount of its assets for future shoppers and the preferences. SOMs map multidimensional information onto lower-dimensional subspaces where mathematical connections between focuses demonstrate their comparability. The decrease in dimensionality that SOMs give permits individuals to imagine and decipher what might somehow be, all things considered, unintelligible information. SOMs produce subspaces with a solo learning neural organization prepared with a serious learning calculation. Neuron loads are changed dependent on their vicinity to "winning" neurons. Convolution Neural Net is a mainstream deep learning method for current visual recognition errands. Like all deep learning methods, CNN is subject to the size and nature of the preparation information. Given a decidedly ready dataset, CNNs are equipped for outperforming people at visual recognition errands. Another order called "deep learning" emerged and applied complex neural organization structures to demonstrate designs in information more precisely than any other time in recent memory. The outcomes are unquestionably incredible.

REFERENCES

[1]. J. Tan and N. Li, "Ensemble Learning Based Multi-Color Space in Convolutional Neural Network," 2019 Chinese Control Conference (CCC), 2019, pp. 7924-7927, doi: 10.23919/ChiCC.2019.8865681.

[2]. Z. Lu, B. Zhang, L. Sun, L. Fan and J. Zhou, "Whale-Call Classification Based on Transfer Learning and Ensemble Method," 2020 IEEE 20th International Conference on Communication Technology (ICCT), 2020, pp. 1494-1497, doi: 10.1109/ICCT50939.2020.9295729.

[3]. Y. Xu, Q. Lin, J. Huang and Y. Fang, "An Improved Ensemble-learning-based CBIR Algorithm," 2020 Cross Strait Radio Science & Wireless Technology Conference (CSRSWTC), 2020, pp. 1-3, doi: 10.1109/CSRSWTC50769.2020.9372466.

[4]. S. Veeragandham and H. Santhi, "A Detailed Review on Challenges and Imperatives of Various CNN Algorithms in Weed Detection," 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), 2021, pp. 1068-1073, doi: 10.1109/ICAIS50930.2021.9395986.

[5]. S. A. Riaz, S. Naz and I. Razzak, "Multipath Deep Shallow Convolutional Networks for Large Scale Plant Species Identification in Wild Image," 2020 International Joint Conference on Neural Networks (IJCNN), 2020, pp. 1-7, doi: 10.1109/IJCNN48605.2020.9207113.

[6]. A. Simonelli, F. De Natale, S. Messelodi and S. R. Bulo, "Increasingly Specialized Ensemble of Convolutional Neural Networks for Fine-Grained Recognition," 2018 25th IEEE International Conference on Image Processing (ICIP), 2018, pp. 594-598, doi: 10.1109/ICIP.2018.8451097.

[7]. Lottes P, Khanna R, Pfeifer J, Siegwart R, Stachniss C, editors. UAV-based crop and weed classification for smart farming. 2017 IEEE International Conference on Robotics and Automation (ICRA); 2017: IEEE. The findings from this paper show that UAV-based images can be successfully used to map and identify weeds.

[8]. Gao J, Nuyttens D, Lootens P, He Y, Pieters JG. Recognising weeds in a maize

crop using a random forest machine-learning algorithm and near-infrared snapshot mosaic hyperspectral imagery. Biosyst Eng. 2018;170:39–50.
[9]. Dyrmann M, Skovsen S, Laursen MS, Jørgensen RN, editors. Using a fully convolutional neural network for detecting locations of weeds in images from cereal fields. International Conference on Precision Agriculture; 2018: International Society of Precision Agriculture.
[10]. Y. Yang, D. Han, and D. Jean, “A ranking distance based diversity measure for multiple classifier systems,” in Proceedings of the 2018 International Conference on Control, Automation and Information Sciences (ICCAIS), pp. 55–60, IEEE, Hangzhou, China, October 2018.
[11]. S. Yang, L. Chen, T. Yan, Y. Zhao and Y. Fan, "An ensemble classification algorithm for convolutional neural network based on AdaBoost," 2017 IEEE/ACIS 16th International Conference on Computer and Information Science (ICIS), 2017, pp. 401-406, doi: 10.1109/ICIS.2017.7960026.
[12]. L. E. Cué La Rosa, P. N. Happ and R. Q. Feitosa, "Dense Fully Convolutional Networks for Crop Recognition from Multitemporal SAR Image Sequences," IGARSS 2018 - 2018 IEEE International Geoscience and Remote Sensing Symposium, 2018, pp. 7460-7463, doi: 10.1109/IGARSS.2018.8517995.
[13]. A. Farooq, J. Hu and X. Jia, "Analysis of Spectral Bands and Spatial Resolutions for Weed Classification Via Deep Convolutional Neural Network," in IEEE Geoscience and Remote Sensing Letters, vol. 16, no. 2, pp. 183-187, Feb. 2019, doi: 10.1109/LGRS.2018.2869879.
[14]. L. Boyina, G. Sandhya, S. Vasavi, L. Koneru and V. Koushik, "Weed Detection in Broad Leaves using Invariant U-Net Model," 2021 International Conference on Communication, Control and Information Sciences (ICCISc), 2021, pp. 1-4, doi: 10.1109/ICCISc52257.2021.9485001.
[15]. A. Elhassouny and F. Smarandache, "Smart mobile application to recognize tomato leaf diseases using Convolutional Neural Networks," 2019 International Conference of Computer Science and Renewable Energies (ICCSRE), 2019, pp. 1-4, doi: 10.1109/ICCSRE.2019.8807737.
[16]. Verma, G., Taluja, C., & Saxena, A. K. (2019). Vision Based Detection and Classification of Disease on Rice Crops Using Convolutional Neural Network. 2019 International Conference on Cutting-Edge Technologies in Engineering (ICon-CuTE). doi:10.1109/icon-cute47290.2019.8991476
[17]. R. Krishna and P. K. V, "Soybean crop disease classification using machine learning techniques," 2020 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER), 2020, pp. 1-5, doi: 10.1109/DISCOVER50404.2020.9278060.