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A Bibliometric Analysis of Plant Disease Classification with Artificial Intelligence using Convolutional Neural Network

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Abstract

In 2021 and the modern future which everyone is going to be a part of, Artificial intelligence is going to be the biggest part of our livelihood. In the future there is going to be a huge expansion of population especially at the rate right now which we are moving but the biggest problem which everyone should be concerned about is the food supply as many of the nations would not be able to feed and make survive their population as even now, there is scarcity of it. Currently in the world the people revolving around the artificial intelligence are dependent on it for many tasks and even for the agricultural purpose they are having an aim to use it as a tool. Once this achievement is accomplished the food shortage problem could be overcome, we should be concern about it because we as humans waste almost 1.6 billion tons of primary food products so slowly we are understanding it and developing new measures like saving food and the most important is to take care of our plants and crops. We are believing that A.I is going to have a key role in it, so we are trying to deploy models using different techniques like Resnet, VCG, Inception, Google NET in different ways to protect our crops and plants. Now as we are going and paving our way to prevent the lack of supply of food through artificial intelligence so we are going to discuss in this study about various researches in artificial intelligence around the world that have been used ,analysis by presenting the actual numbers of paper sources or research that has been done till now, and also which countries are primarily progressed in it and the top numbers of languages contributed towards this research and even the recent number of studies which are been performed on new architecture developed for this purpose. We have also mentioned a few statistical analyses on datasets, Frameworks and data analysis methods used across worldwide.

Keywords: Plant Disease, Artificial Intelligence, Convolutional Neural network, Prediction, Classification

1. Introduction

Agriculture is the growing backbone of any country as it could increase or decrease the economy of it. Currently the agricultural sector is facing issues because of industrialization and globalization principles. Even the younger generation's minds must be provided with a sense of reality and the conciseness regarding cultivation. today's world has got a huge amount of money invested in technology which has a critical role in all the fields of human existence, but till now not much in agriculture, because we are continuing to depend on outdated methods or past methods. Plant diseases decrease the standard and number of agricultural products. A wrong diagnosis of any plant disease could be resulting in a significant loss of land, time, natural resources, money time and most importantly its quality. For worldwide heartiness and wellness, it is very important to detect any plant diseases at a very early stage right before its spread. Currently the detection of plant diseases through improving technologies are automatically becoming a very popular research topic. It would be helping in the monitoring of numerous sizes of crop fields and the prevention of infections and harmful spread of it when they are discovered on the farming land or on crops/plants. The number one consciousness of this paper is on figuring out plant illnesses to be able to limit crop loss and consequently improve manufacturing units. Using an artificial intelligence technique, to identify the signs of plant diseases at an early level and classify the disease based on the signs and symptoms shown by the plant or the crop is very crucial for the crop. Due to the beginning stage of artificial intelligence, deep learning was only used earlier to

make an artificial intelligence do work but after the progress in technology and innovative thinking machine learning approach was introduced [1]. Machine learning was introduced in the year 1943 [2]. After its initialization it was not much used for work or application purposes as there were many few who had an exposure to it but, in simply terms lack of exposure to the technology, lack of environment. But soon as the technology started to be used by person to person the effect of deep learning techniques was observed in the 2000 era [3]. The machine learning took ten years to be a large-scale recognition around 2010. While the technology was developing but still was started to be used as an alternate for crops and plant diseases cure in very early years. In early stage the technology was not evolved much like no high-quality cameras, no devices for communications as we are having now, no internet services etc. So it was practically very difficult to make these algorithms, data-sets to be used but still the work was initiated by few of the people like Uchiyama et al gave two data-sets for 3d plant phenotyping which had various of crops pictures clicked by three number of camera to construct it digitally as a 3d object and use it [4].But nowadays we are having humongous number of technology like we have got great facility known as camera in even our mobile phones ,we have got high quality digital cameras which have very high resolution and focus etc. which are used currently for data-sets collection of a plant nowadays. Due to revolving technologies Artificial intelligence (AI) is performing a key component in supplanting everyday strategies with fast, effective, computerized, cost-powerful, and, maximum vitally, specific techniques for recognizing plant illness. The application of computer-based totally image managing innovation in rural designing investigate, yields tremendous outcomes about the ability of a programmed technique for figuring out diseases and their cures in plants so that we could protect them at a very early stage before the destruction is done. Decision Trees, Back Vector Machines (SVMs), Fake Neural Systems (ANNs), Machine Learning (ML), and Profound Learning are some of the namely computing strategies utilized today for plant's disease contamination category (using DL).When as compared to the shallow ML algorithm, the evolution of DL strategies has shown appreciably higher performance and profound learning exhibit approaches in the discipline of category and discovery with the essential profound learning device of Convolutional Neural Networks (CNNs) [5]. CNNs are an active display that facilitates the category of expansive sums of information in type programs. The potential to make use of the CNN to extricate the discovered work on the agricultural environment is being processed and is being researched around worldwide currently for such problems.

The topmost technology or feature used in the artificial intelligence for specifically using images as a dataset is the Convolutional neural network [6]. It has Convolutional layers which are collections of photograph channels convoluted to pics or spotlight maps and are combined with different layers (together with pooling) to make CNNs. Not at all like ordinary device/algorithm studying strategies that depend on hand-crafted highlights, CNN optimizes the weights and channel parameters in the protected-up layers to create highlights that are becoming for solving the type of difficulty given in a preparing dataset [7].

2.1 Important Keywords

Important keywords associated with plant disease were divided into following part as shown in the Table 1.

Table 1. Publications search Keywords for Plant disease

Primary keyword	“Plant Disease”
Secondary keyword using (AND)	“Artificial Intelligence”
Secondary Keyword using (OR)	"Convolutional Neural network", "Prediction" "Classification"

Hence the question used to search publications in Scopus is "Plant disease" AND "Artificial Intelligence" OR "Convolutional Neural network" "Prediction" OR "Classification".

2.2 Prerequisite search results

The basic database for this research paper is the Scopus database, the keywords used for searching the database showed 209 publications. Table 2 summarizes types of publications in plant disease and its percentage in the Scopus database [8]. One thing that can be clearly depicted from this table is that most of the published data around the world regarding plant diseases are articles and secondly conference papers.

Table 2. Types of Publications in Plant Disease

Types of publications	**Publication count**	**Percentage**
Journal	106	50.77%
Conference Paper	74	35.40%
Book series	29	13.87%
Total = 209		100%

Dataset information source: https://www.scopus.com (Accessed on 29th May 2021)

2.3 Publications based on languages

Table 3. Languages used in Publications for Plant Diseases

Publications Language	**Publication count**
English	196
Chinese	8
Turkish	3
Korean	2

Dataset information source: https://www.scopus.com (Accessed on 29th May 2021)

2.4 Publication count per year

The documents related to plant disease had been retrieved for the span of 156 months beginning from 2006 to 2021. By studying this statistic, it can be analyzed that the research region has contributed better to the year 2018 and 2021. However very few research turned into accomplished within the span of year 2015 to 2017 and published in various journals [9]. It clearly depicts that people are now getting and showing concern regarding the crop problems and food related issues.

Table 4. Publication counts from year 2008-2020

YEAR	Publication Count
2021	46
2020	85
2019	41
2018	14
2017	10
2016	5
2015	3
2013	3
2009	1
2006	1

Dataset information source: https://www.scopus.com (Accessed on 29th May 2021)

In Figure 1 the chart representation of Table 4 that represents the Number of publications in the field of Plant Disease Detection based on Artificial Intelligence from 2006 to 2021 [10].

2.5 Subjective analysis

Now the given below Figure 2 shows different sections of publications for plant diseases according to various subjects used in it [11]. It can be easily concluded from this figure that most of the research is carried out in the Computer Science area followed by the agricultural and biological sciences area. Few researches have been carried out in the area of energy. As it also shows mostly the plant diseases research are concluded by the technological related subject like computer science which encourages the growth of learning of plants and their diseases by using machines

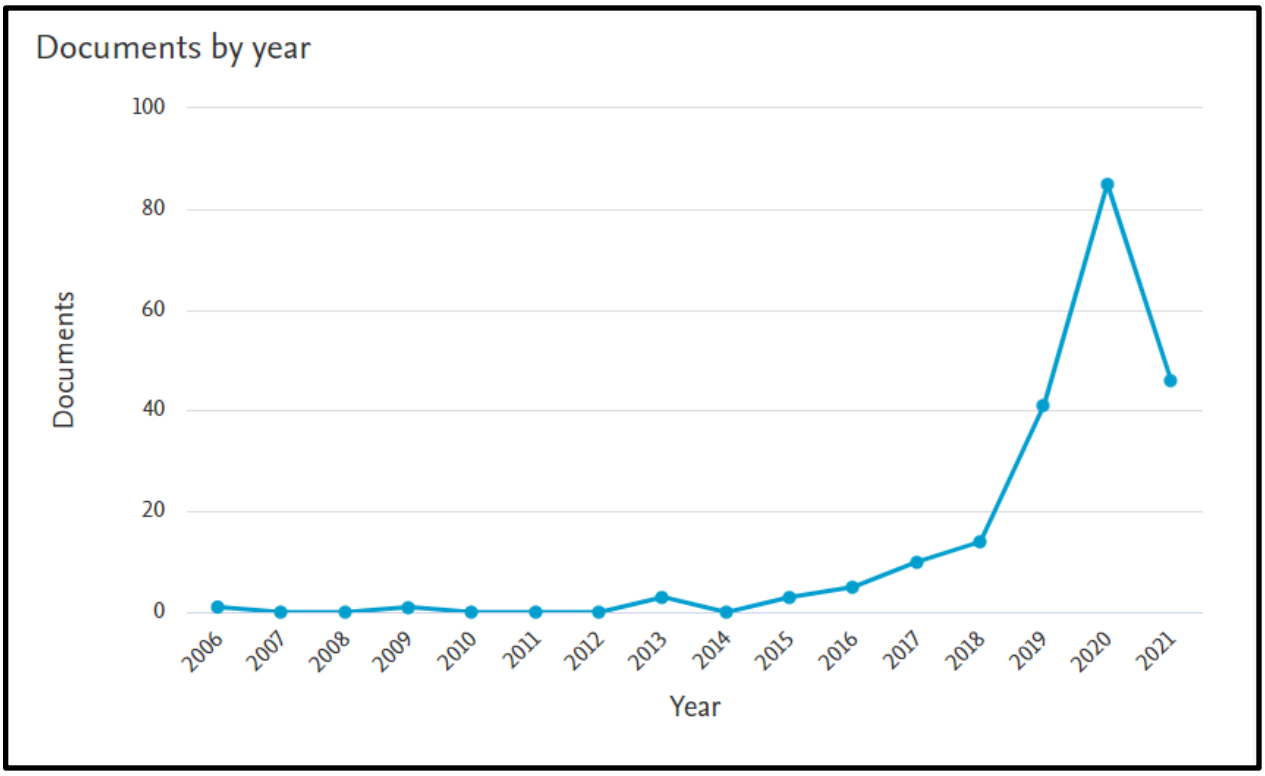

Figure 1. Number of Documents published per year

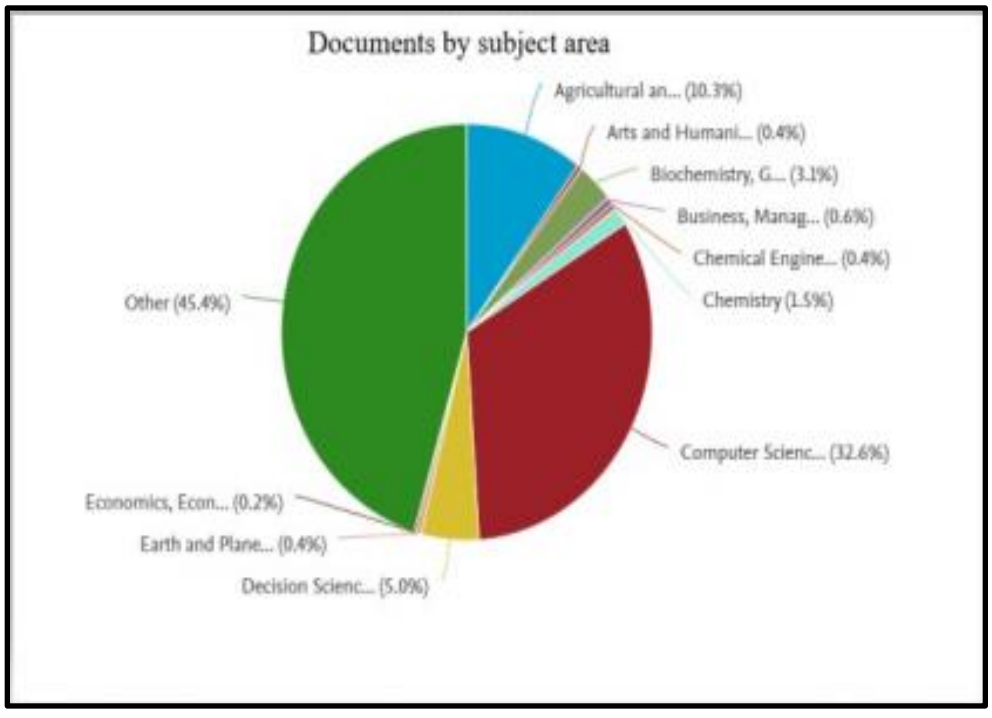

Figure 2. Documents by subject area

2.6 Statistical analysis by Authors

From the given below Figure 3 it is illustrated that the highest number of documents and research concluded on plant diseases are of Chang J and Nanekharan Ya [12]. They have done many deep-rooted analyses over this subject region and also have researched about it a lot.

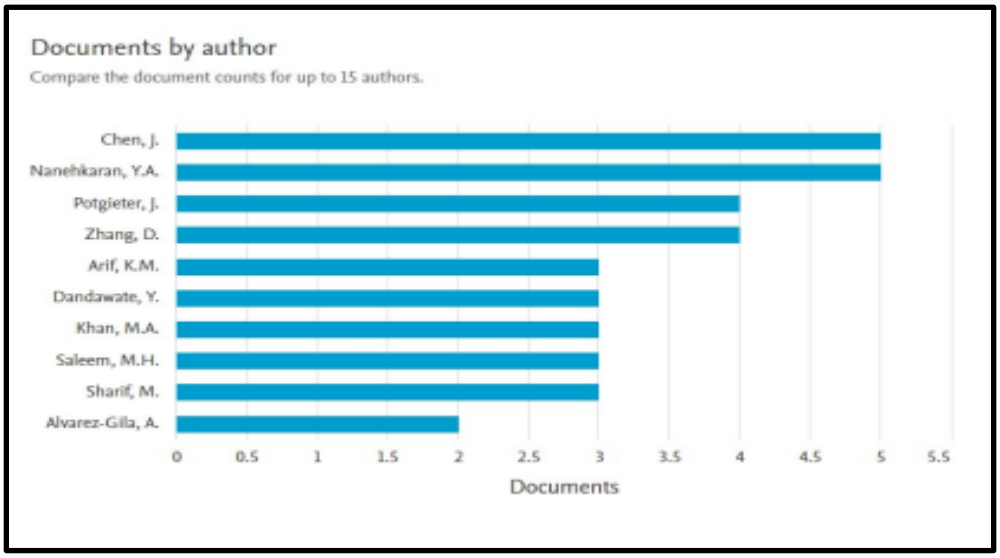

Figure 3. Analysis by Number of authors

2.7 Affiliation analysis

The given below Figure 4 shows about the top ten universities who are leading in research analysis on Plant diseases [13]. From this it can be easily depicted that the Xiamen university is in the lead compared to all others and following it the Vellore institute is the second most leading affiliations to be doing research regarding plant diseases and even from the given figure we can take it as among the top 10 universities across the world three of the universities belong to India which the SRM institute, Delhi Technological university, and the Vellore institute of technology.

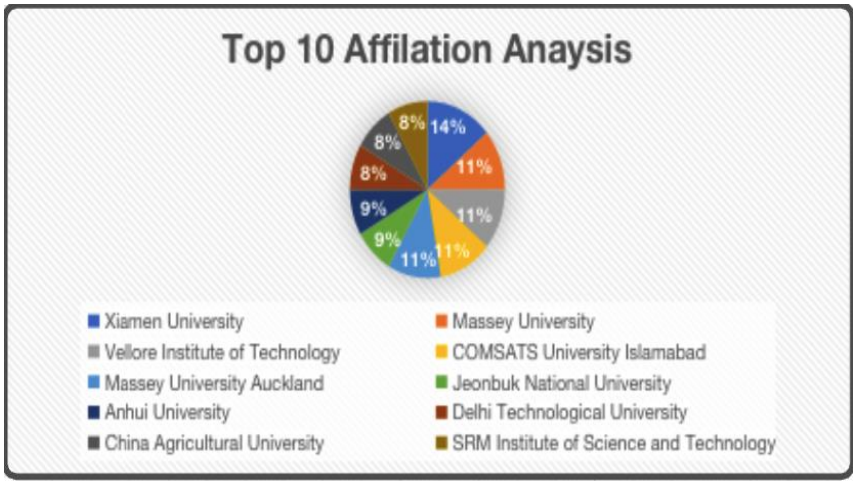

Figure.4 Survey on Affiliation analysis

2.8 Source type analysis

Now from the given below Figure.5 it is clearly depicted about the types of sources found across worldwide regarding plant diseases [14]. The most highly used sources are Journal and then following them are the conference papers and book series. There is a huge demand and importance of these Journals across the world as they provide a permanent record and any researcher's ideas and progress of work in that field.

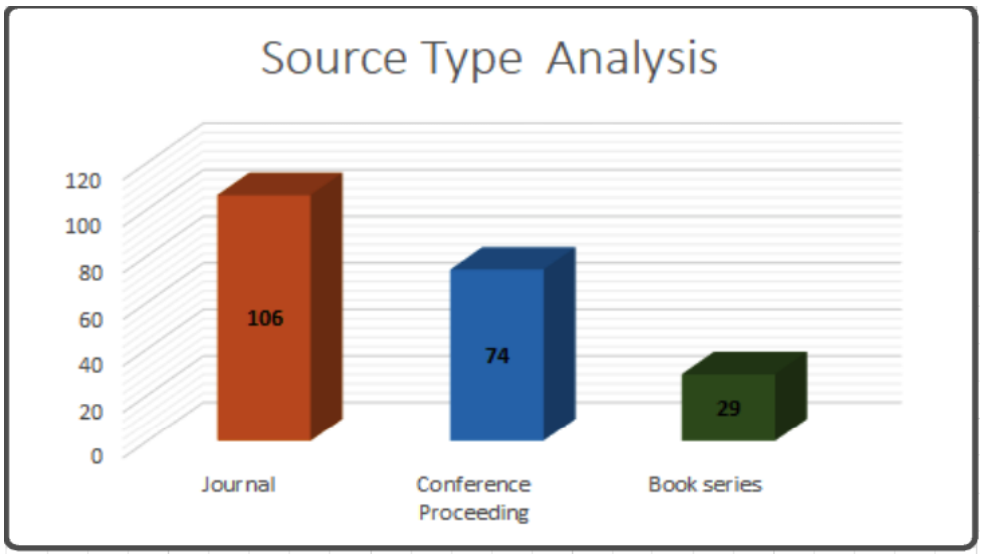

Figure. 5 Source type analysis

2.9 Country wise analysis

Now in the given below Figure 6 shows the graphical analysis of Table 5 of leading countries who are having their publications in the field of plant diseases [15]. It is clearly illustrated as India is having the highest number of publications around the whole world and the following is China which is nearly half of what India has provided.

Table 5. Number of Scopus publications in different countries

Country	**Number of Scopus publication**
India	101
China	47
United States	15
Pakistan	8
South Korea	8
Bangladesh	7
Turkey	7

Malaysia	6
Brazil	5
Germany	5

Dataset information source: https://www.scopus.com (Accessed on 29th May 2021)

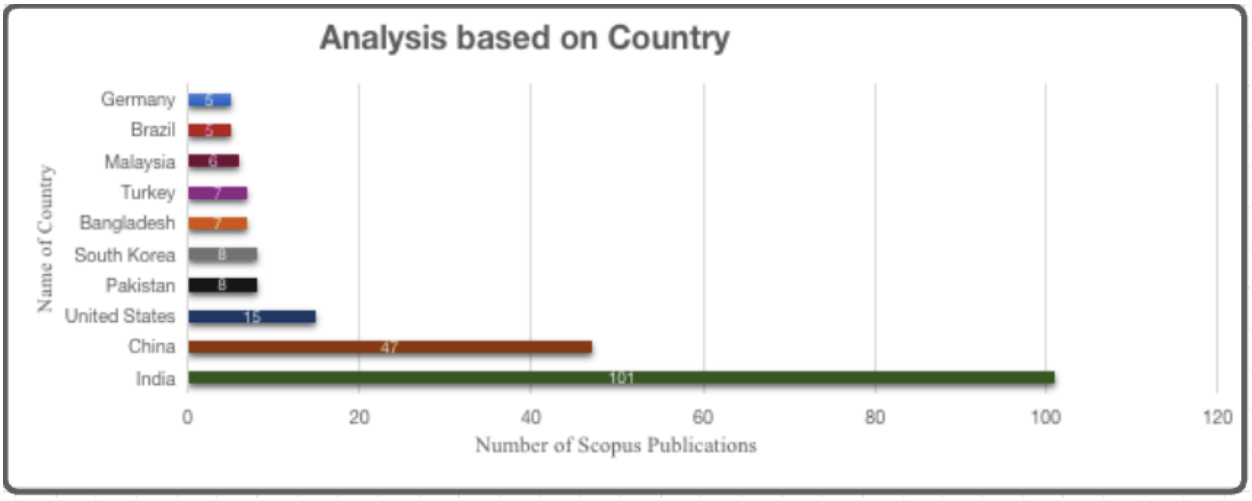

Figure 6. Analysis based on country

2.10 Analysis based on documents by organizations

In the given below Fig 7 it is clearly provided that the computers and electrons have been significantly contributing the research and study towards plants and its diseases but from the year 2017 the advances in intelligent systems and computing has increased it to a next level [17].

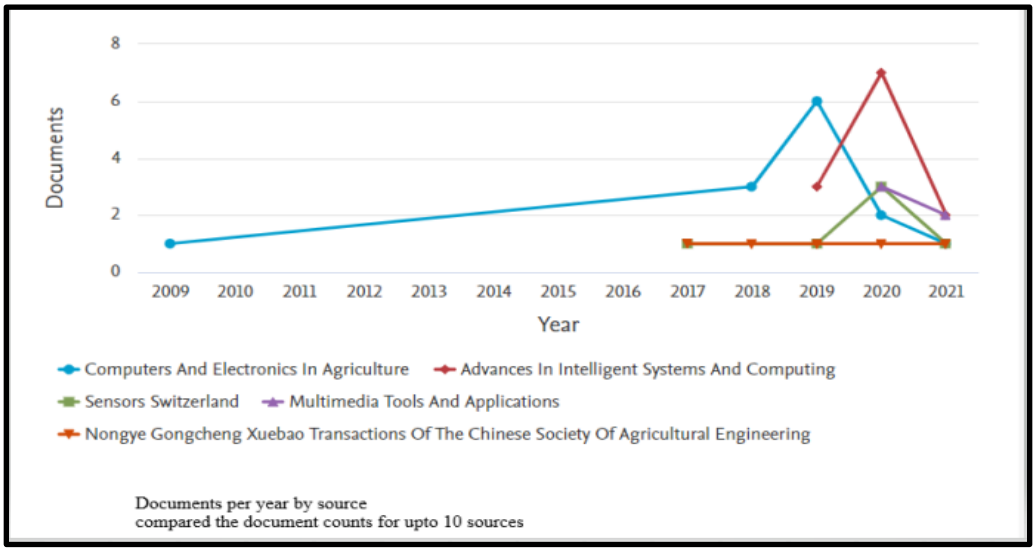

Figure 7. Analysis by documents of different organizations

3. Bibliometric survey

Figure 8 given below shows the distribution of publications and research done in terms of different countries [19]. These countries are either the top modern countries or countries with huge populations and having lack of food problems or scarcity problems. Out of the 209 research papers published most are from India only. All these countries have a large landscape for cultivation but few of them are not able to utilize it properly as they are still having problems [20]. All of them are also mass international exporters of crops also so their degradation of crop quality would even affect other countries' situation as other countries are majorly dependent on them [21].

Figure 8. Geographical analysis of research on plants diseases

4. Future Research Direction

Artificial Intelligence is speedily becoming a part of agriculture's technological evolution. By 2050, the aim is to increase food production globally by 50% to feed an additional two billion people [22]. Al-powered solutions will help farmers boost efficiency, and help them increase crop quantity, quality, and speed up time to market.The current focus according to the survey done should be toward few key aspects like we should increase the researches around the other countries also [23].For plant disease detection using method like machine intelligence we must empower and built our cores of computer science and we should try to keep finding and enhancing diverse data-sets so that it could have a great performance in the practical usage of such plant diseases working models and also we must focus on creating new architecture further so that the evolution should further increase [24].We must also increase the research papers published on plant diseases and share new methods and techniques or some technologies to enhance the old ones or to upgrade them [25].

5. Future use of artificial intelligence in agriculture

Many potential applications of artificial intelligence in farming and agriculture, prevention in plants diseases is possible, and as they could be a one-time investment that provides long-term security and care for our plants and entire farms and humans

- Artificial intelligence may be used to estimate crop yields and even market forecasts in the future [26].
- They can not only be used to diagnose diseases, but also to spray pesticides and antibacterial drugs on it intelligently.
- They can be used for clustering and classification of different types of crops altogether so that they do not mix up [27].
- They can be used for predictive analysis by analyzing the images of plants/crops and predict whether the plant is growing at a proper pace or fast pace and could monitor its health [28-29].

6. Limitations of the present study

The publications that are available only in Scopus database are considered for the present study. There may be scientific documents from other research databases such as Web of Science, Google Scholar that are not considered for the current research analysis. Mostly for different countries having different weather condition all along year would create few difficulties as the A.I model deployments in those regions might get affected and its performance could go down. After even so much of evolution in technology still models based on machine intelligence to work at such a large scale like hectares square is very difficult. Even till now there are many countries which are not yet trying to contribute towards these research which could be resulting in a negative impact on the global food index. Now moving towards the last factor but not the least is the level as we know that machine never lies or does wrong until and unless it is used like that and it always does its work ideally but still coming to the practical world specially for the agricultural purpose, we cannot get an actual 100% level perception by anything like a machine. Mainly whatever a farmer can, at that perception and accuracy a machine can never work with the existing technological support.

7. Conclusion

This bibliometric study is used to evaluate the current situation and having a brief realization in the field of using artificial intelligence for plant disease detection. These deep surveys illustrate many things such as the improvement of technology from the early 2000s.This study also provides a brief statistical way to know about the top authors regarding the topic plant and diseases and not only this but also shown about the top affiliations which have contributed their research about plant diseases among which from the top ten affiliations three belonged to India. It also shows about different major languages used to publish our topic based article, conference paper etc,the types of papers written. We also survey an analytical study about the major source types which are published worldwide and are used for references among which the top were the journals and

following by conference papers. Whereas taking it even to a global level India has got the highest number of publications all around the world. The study also revealed that the progress is getting day by day increased exponentially. The findings of the entire study finally concluded that we must use technology for great use and should be keep progressing in these field of research otherwise, if we do not focus on these problems today it will not be good for future of humanity.

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