A review on the role of IoT, ai, and blockchain in agriculture & crop diseases detection using a text mining approach

Una revisión sobre el papel de IoT, AI y Blockchain en la detección de enfermedades agrícolas y de cultivos mediante un enfoque de minería de textos

Uma revisão sobre o papel da IoT, IA e Blockchain na detecção de doenças agrícolas e de colheitas usando uma abordagem de mineração de texto

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Abstract

Introduction: This paper is the outcome of a review survey, "Role of IoT, AI and blockchain in agriculture and crop disease detection using a text mining approach," done at Lovely Professional University in Punjab, India, in 2023.

Problem: Agriculture is a crucial industry that contributes significantly to the economies of many nations. Crop diseases are one of the issues that create a barrier to agricultural development.

Objective: Using machine learning, deep learning, image processing methods, the Internet of Things, and blockchain technology, this study provides a current summary of research done over the past years on disease identification of various crops.

Methodology: The text mining technique is applied to extract the related information from published papers and predict the following futuristic technologies to detect crop diseases early.

Results: This paper also covers the various issues, challenges, and potential solutions. It also emphasizes the wide range of tools available for identifying crop diseases.

Conclusion: This paper helps to extract valuable keywords through a text-mining approach and create a roadmap for another researcher.

Originality: Applied text mining visualization techniques, such as word cloud and word frequency, to extract the keywords.

Limitation: The literature survey only covers literature published prior to February 2023; it can be extended with more studies published soon.

Keywords: IoT, Crop Diseases, AI, Blockchain, Agriculture, Text mining

Resumen

Introducción: este artículo es el resultado de una encuesta de revisión, "El papel de la IoT, la IA y la Blockchain en la agricultura y la detección de enfermedades de los cultivos mediante un enfoque de minería de textos", realizada en Lovely Professional University en Punjab, India, en 2023.

Problema: la agricultura es una industria crucial que contribuye significativamente a las economías de muchas naciones. Las enfermedades de los cultivos son uno de los problemas que crean una barrera para el desarrollo agrícola.

Objetivo: usando machine learning, Deep learning, métodos de procesamiento de imágenes, Internet de las cosas (IoT) y tecnología blockchain, este estudio proporciona un resumen actual de las investigaciones realizadas en los últimos años sobre la identificación de enfermedades de diversos cultivos.

Método: la técnica de minería de textos se aplica para extraer la información relacionada de artículos publicados y predecir las tecnologías del futuro para la detección temprana de enfermedades en los cultivos.

Resultados: este documento también cubre los diversos problemas, desafíos y posibles soluciones. También enfatiza la amplia gama de herramientas disponibles para identificar enfermedades de los cultivos.

Conclusión: este artículo contribuye a la extracción de palabras clave relevantes mediante un enfoque de minería de textos y a crear una hoja de ruta para otros investigadores en el área.

Originalidad: técnicas de visualización de minería de texto aplicadas, como nube de palabras y frecuencia de palabras, para extraer las palabras clave.

Limitación: la revisión solo cubre la literatura publicada antes de febrero de 2023; se puede ampliar con más estudios publicados posteriormente.

Palabras clave: agricultura, Blockchain, enfermedades del cultivo, Internet of Things, inteligencia artificial, minería de texto.

Resumo

Introdução: Este artigo é o resultado de uma pesquisa de revisão, "Role of IoT, AI and Blockchain in Agriculture and Crop Disease Detection Using Text Mining Approach", realizada na Lovely Professional University em Punjab, Índia, em 2023.

Problema: A agricultura é uma indústria crucial que contribui significativamente para as economias de muitas nações. As doenças das culturas são um dos problemas que criam uma barreira ao desenvolvimento agrícola.

Objetivo: Utilizando aprendizado de máquina, aprendizado profundo, métodos de processamento de imagens, Internet das Coisas (IoT) e tecnologia blockchain, este estudo fornece um resumo atual das pesquisas realizadas nos últimos anos sobre a identificação de doenças de diversas culturas.

Método: A técnica de mineração de texto é aplicada para extrair informações relacionadas de artigos publicados e prever tecnologias futuras para detecção precoce de doenças em culturas.

Resultados: Este documento também aborda os vários problemas, desafios e possíveis soluções. Também enfatiza a ampla gama de ferramentas disponíveis para identificar doenças nas culturas.

Conclusão: Este artigo contribui para a extração de palavras-chave relevantes utilizando uma abordagem de mineração de texto e para a criação de um roteiro para outros pesquisadores da área.

Originalidade: Aplicou técnicas de visualização de mineração de texto, como nuvem de palavras e frequência de palavras, para extrair as palavras-chave.

Limitação: A revisão cobre apenas literatura publicada antes de fevereiro de 2023; Pode ser ampliado com mais estudos publicados posteriormente.

Palavras-chave: agricultura, Blockchain, doenças agrícolas, Internet das Coisas, inteligência artificial, mineração de texto.

1. INTRODUCTION

Nowadays, technological innovations such as autonomous farming, precision agriculture, and advanced crop disease detection techniques fuel rapid growth in the agriculture industry [1]. Humans have created innovative methods to increase farming productivity and produce more food, from the invention of the plough to navigation of precise farming tools [2]. Modern agricultural operations usually use high-tech equipment like GPS, aerial photography, temperature and moisture sensors, and robotics to increase agricultural output. Agriculture is changing because of digitization [3], which presents new opportunities to improve farmer policies. Crops are essential for maintaining the ecological cycle and food chain pyramid. The rapid advancement of technology has changed and enhanced every aspect of human lifestyle, especially the agricultural industry. Crop disease [4] is one problem that limits the effectiveness of contemporary agricultural methods. Since they generate significant food and financial losses, crop diseases continue to threaten the world's food supply. Yet, the ability of intelligent mobile plant disease diagnostic systems [5] to diagnose and detect plant diseases early using live images has increased their utility, mainly when there is a need for more access to competent and sufficient experts. Several studies have been put forth in recent years to deal with the early identification of crop diseases using various techniques. The improvement of agriculture and the early detection of plant diseases are both greatly aided by artificial intelligence (AI).

Also, it can increase the agroecological system's management and crop security [6]. Authors in [7] proposed a thorough strategy for identifying crop disease using machine learning (ML) and deep learning (DL) methods and highlighted the superiority of DL over ML techniques as well. The authors of [8] [9] [10] presented an AI-enabled plant detection method that would be used to identify the illness on the leaf using a vision camera and soft computing techniques. Although these strategies are adequate for detecting crop diseases in their early stages, some restrictions are needed to improve the effectiveness of AI detection techniques. To train and validate a model for precise detection and classification, sophisticated methodologies necessitate high-quality images of crop diseases [11]. The necessity for farmers to gain additional knowledge regarding the agriculture diseases is the other problem, which may reduce the effectiveness of the real-time monitoring system [12]. In order to manage the crop-growing environment and provide real-time monitoring of the crops to prevent the spread of crop diseases, an IoT-based plant monitoring system has been proposed [13]. Integration of IoT and AI makes it possible to forecast outcomes more accurately. Applying cutting-edge technologies in agriculture, particularly in the fight against crop diseases, also presents some difficulties. Numerous academicians have been using IoT, AI and blockchain technology in recent years to enhance agriculture practices and identify crops disease. The sheer volume of papers published makes it challenging for the researcher to pinpoint the relevant terms, unsolved problems, and applications of these technologies. In order to address these problems, an investigation is suggested to look into the most recent development in crop disease identification. The study's contribution is as follows:

a) The text mining technique is applied to extract the frequent words from published articles on agriculture and crop diseases.
b) Highlight the open issues and challenges in crop disease identification techniques.
c) Emphasize various applications to detect crop diseases.

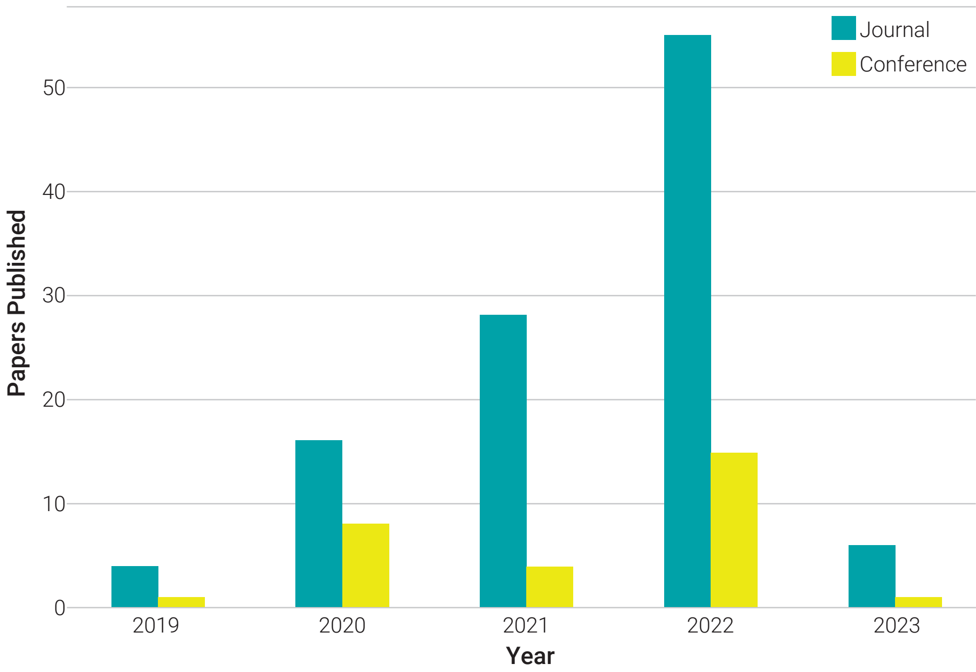

Figure 1. Collected published papers related to IoT, AI and Blockchain in agriculture.
Source: Own Work

The remaining study findings are as follows: Section 2 shows the related work to the proposed work, Section 3 discusses the methodology of the proposed work, Section 4 emphasizes the unresolved problems and difficulties in detection methodologies, Section 5 emphasizes the application part, and Section 6 concludes the study and discusses the limitations and potential future applications of the study.

2. RELATED WORK

This section discusses an overview of agriculture and crop diseases and highlights the role of IoT, AI and blockchain in agriculture and crop diseases.

2.1. Overview of Agriculture

Globally, agriculture is a significant industry. Producing goods like beef, chicken, eggs, dairy, and wool entails producing cattle, poultry, and other animals and growing crops like corn, cotton, soybeans, and fruit [14]. Cultivating the soil, growing crops, and rearing livestock are all part of agriculture, both an art and a science. The productivity of agriculture has increased significantly because of recent scientific developments.

Agricultural development is one of the most powerful strategies to reduce severe impoverishment and improve shared prosperity [15]. Farmers must overcome many difficulties in modern farming to satisfy the increasing demands of our planet and those of policymakers, customers, food producers, and retailers. Anthropogenic global warming, which has caused unpredictable weather patterns, droughts, floods, and other extreme weather events, is one of the significant problems. These modifications directly affect agricultural production and have the potential to cause food shortages [16][17][18][19]. Agriculture technology has evolved into a new era in recent years. Farmers now use autonomous harvesters and tractors, drones, planting, and weeding to revolutionize how they cultivate their crops.

2.2. Overview of Crop Diseases

Identification of crop diseases is essential for evaluating agricultural performance in its entirety [20]. The agriculture of various nations raises a wide range of crops, including tomato, rice, and other sorts. The capacities of the roots and leaves will determine how each of these crops develops. When there are unhealthy conditions, several diseases can harm plants' leaves, lowering crop yield and ultimately impacting the economy of the country [21] [22]. The detrimental impacts of crop diseases can be limited by early diagnosis. Accurate crop disease detection techniques are required for the nation's agriculture to thrive. Figure 2 represents the crop diseases and their types [23]. The crop diseases are classified into two different categories:

a) **Abiotic:** These illnesses are not caused by living organisms but rather by environmental conditions outside the plant. Abiotic diseases can be further divided into nutrient deficits, soil compaction and sun scorching.
b) **Biotic:** These diseases are the result of living creatures. They are known as plant pathogens when they infect plants. Biotic diseases are further classified into fungal, bacterial and viral diseases.

2.3. Role of IoT in agriculture and crop disease detection

The Internet of Things (IoT) is a new paradigm that uses connections between the physical and digital worlds to try and solve problems that people face daily. In the IoT, many things in our surroundings that are sentient and have the capacity to collect, process, and send data are connected [24]. The use of IoT technology in numerous parts of the agriculture sector are as follows:

a. Precise agriculture:

By using several targeted, crucial interventions, precision farming is a set of strategies and procedures that assist farmers in enhancing and boosting soil quality and productivity. Because of the advancement of ever-sophisticated technologies, this is conceivable**.** The studies [25] [26] highlight how crop management tools are necessary for the efficient application of precision agricultural technology. There are some suggested IoT-based precise agricultural frameworks [27][28][29] for solutions.

b. Water Management

Water is the primary crucial component for the existence of life on this planet. Effective water usage will be necessary for farming growth, so it is crucial to employ water-saving methods. The utilization of the IoT has recently increased and reached new levels. IoT plays a very important role in the agriculture system. In recent years, there are some studies [30] [31] that introduced IoT systems in agriculture for water management.

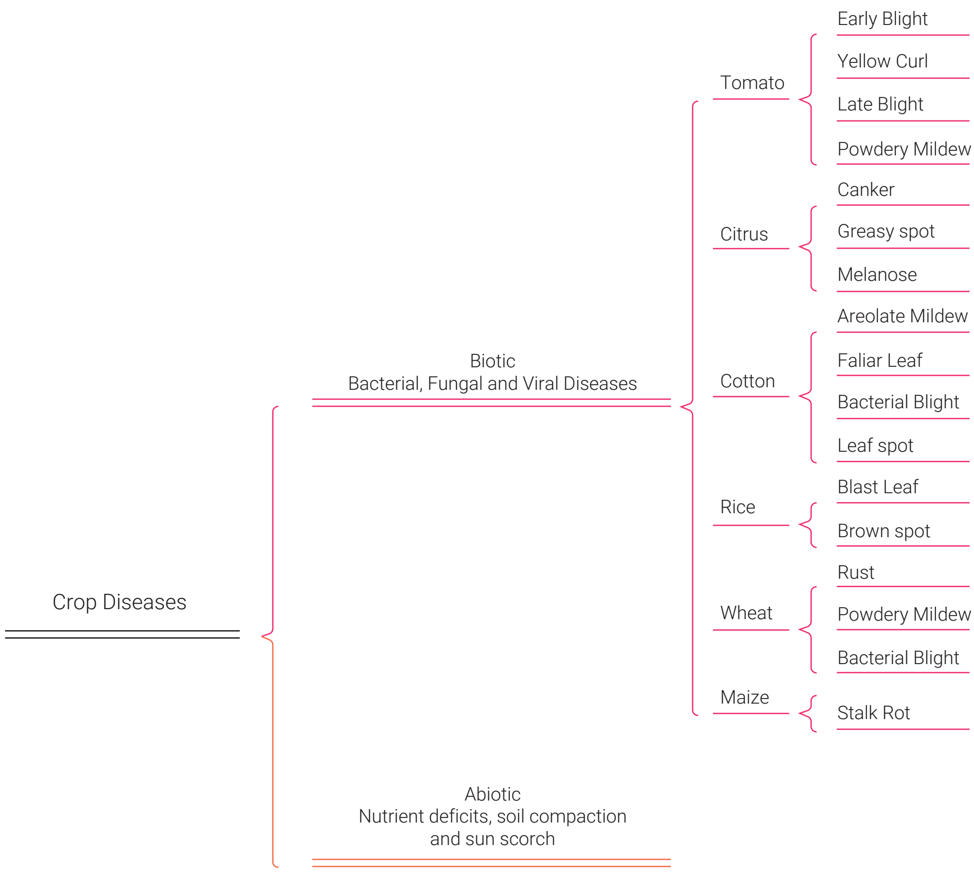

Figure 2. Overview of Crop Diseases
Source: Own work adapted from [23]

c. Livestock management

There is a significant variation in production, according to several surveys, because farmers are still using traditional agricultural methods. The main issue is managing and organizing the expansion of the cattle industry to close the yield gap. In recent years, some studies have proposed [32][33][34] IoT-based livestock management systems that can make complex decisions, and data processing is frequently carried out on the cloud or on faraway servers.

2.4. Role of AI in agriculture and crop disease detection

In the agricultural industry, AI is utilized for many different things, including yield monitoring, soil management, insect identification, and many other things.

a. Improved Decision making:

In recent years AI has benefitted numerous agricultural undertakings. In [35], AI enhances decision-making. Predictive analytics has several key game-changers. Farmers can examine and collect a much greater volume of data with AI than they could without it. A few of the major problems that farmers may employ AI to address include the analysis of market demand, price forecasting, and choosing the ideal planting and harvesting window.

b. Reduced resource and costing

Precision agriculture enabled by AI may revolutionize the agricultural sector [36]. To assist farmers, raise yields and cut costs, precision farming blends topsoil management techniques, variable rate technologies, and the best data management approaches. Fields that require irrigation, fertilization, or pesticide application can be located by farmers using real-time AI insights.

c. Autonomous AI

Precision farming [37] combines top-soil management methods, variable rate technologies, and the best data management systems to help farmers increase yields and reduce expenses. Farmers can detect fields that need irrigation, fertilizer, or pesticide application using real-time AI insights.

2.5. Role of Blockchain Technology in agriculture and crop diseases

Blockchain technology has the potential to significantly impact agriculture by enhancing food safety, increasing openness and accountability in supply chain networks, and enabling data traceability throughout the agricultural supply chain. There are several approaches to use the blockchain in agriculture and crop diseases:

a) **Management [38]:** A further use for blockchain technology is the management of the agricultural supply chain, which includes monitoring product storage and transit.
b) **Track and Monitor Crop Diseases [39]:** Farmers can use sensors and other monitoring tools to collect crops data and store it on a blockchain.
c) **Traceability [40]:** Food products may now be traced thanks to blockchain technology, ensuring their safety and top quality from farm to table. With blockchain, farmers can monitor their products' entire supply chain, from the seed to the retail shelf.
d) **Crops Insurance [41]:** The management of crop insurance using blockchain will make it easier for farmers to get the coverage they need. Blockchain technology allows insurers to verify farmer data, such as crop yields and weather patterns, which boosts the accuracy and dependability of the insurance process.

Table 1. Studies considering the different parameters in their related work.

Studies	Agriculture	Crop / Plant Diseases	IoT	AI	Blockchain
[25][26]	✓	✗	✗	✗	✗
[24] [27]	✓	✗	✓	✗	✗
[42]	✓	✗	✓	✓	✗
[43]	✓	✗	✓	✓	✗
[44]	✓	✗	✓	✓	✗
[45]	✓	✓	✓	✓	✗
[46]	✗	✓	✗	✓	✗
[47]	✓	✗	✗	✓	✗
[48]	✓	✓	✗	✓	✗
[49]	✓	✗	✓	✗	✗
[50]	✓	✗	✗	✓	✓

(continúa)

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Studies	Agriculture	Crop / Plant Diseases	IoT	AI	Blockchain
[51]	✓	✗	✓	✗	✓
[52]	✓	✓	✓	✓	✓
[53]	✓	✓	✗	✓	✗
[54]	✓	✓	✗	✓	✗
[55]	✓	✓	✓	✓	✗
[56]	✓	✓	✗	✓	✓
[57]	✓	✗	✓	✗	✓
[58]	✓	✗	✓	✓	✗
[59]	✓	✓	✓	✓	✗
[60]	✓	✓	✓	✗	✓
[61]	✓	✗	✗	✗	✓
[62]	✓	✓	✗	✓	✗

3. METHODOLOGY

In this section, architecture design is discussed (see Figure 3). The proposed architecture, which is structured into four sections for data gathering, preparation, selection, and visualization, is as follows:

a. Data Collection:

In academics, data collection gathers and analyses information from numerous sources to produce insights and valuable data for future investigations. The information is gathered from many sources using a variety of approaches, which are then utilized to analyze the data and decide how to use it to get the most valuable results for the research [63]. For this study, data is gathered from the AGORA portal, which includes various sources such as Web of Science, ScienceDirect and other repositories, to identify issues and trends in crop or plant diseases.

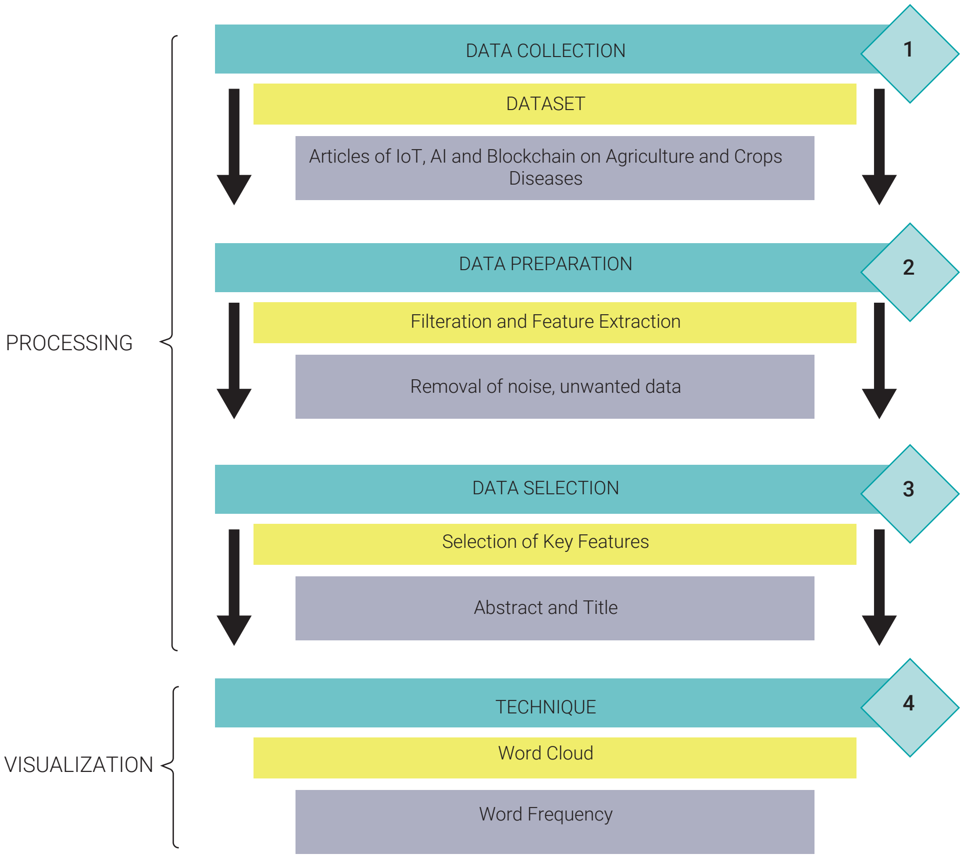

Figure 3. Framework of proposed methodology
Source: Own Work

b. Data Preparation

After collecting the data, the next step is to extract or filter the valuable information [64]. The data preparation process includes steps for data cleaning, noise reduction, correctness, uniformity, and other things. Additional steps to reduce the dimensions may be required depending on the dataset because too many features may slow down any subsequent computation. With only pertinent data and the exclusion of extraneous data, the feature selection procedure lowers the input variable to the model. The two main activities in natural language processing (NLP) are feature extraction and feature selection. Whilst the goals of feature extraction and feature selection are similar, the activities differ significantly.

c. Selection

Numerous parameters or features are available in the NLP task; however, only some help extract meaningful information [65]. The crucial process of selecting the data helps guarantee the quality and relevance of the text corpus. In this study, two features are selected to analyze the related work studies a) title and b) abstract and the rest of the information could not be more useful as abstract and title.

d. Visualization

Data Visualization is the better step in NLP tasks when trying to understand the input and output. This study uses word cloud or tag cloud [64] to visualize the experimental outcome understandably. A word cloud, often called a tag cloud, is a visual representation of text data in the form of tags, typically single words, the relevance of which is denoted by the size and color of the tag. Text mining [66] has become a vital and popular part of data mining. Text mining has numerous real-world uses in various industries, including business, healthcare, crime prevention, and cyberbullying.

Experimental Testbed

A personal computer with an I7 processor, a 128GB SSD, and 8GB of RAM is employed in the experimental setup, and Python and its supporting libraries are used to extract the useful keywords from the collected dataset. Calculations for data visualization and word frequency are made using the N-gram and word cloud.

Workflow of the Methodology:

Step 1: Data is collected from the AGORA [67] in the first step. The keywords considered for this study to extract related papers from the database are “blockchain in crop or plant diseases”, “IoT in crops or plant diseases”, “AI in crops or plant diseases”; preparing a custom database for further analysis.

Step 2: The feature selection process extracts the valuable features in the next one. “Title”, “abstract”, “citation”, “article category: journal, conference, or book chapter,” and “keywords” are the elements of the information gathered. “Title” and “Abstract” are the only features that may be used to extract meaningful information from the database that has been compiled; the other features are not as potent for this study.

Step 3: After applying text-mining techniques to the collected dataset, the main steps considered in the text mining to visualize the word cloud are 1) convert text column as string 2) convert the text into lowercase 3) remove everything which is not character 4) remove words which are less than 3 characters and 5) stripping extra spaces. The Word Cloud for the “Abstract” and “Title” is generated individually. Figure 4 represents the data extraction for “Abstract” and “Title” respectively.

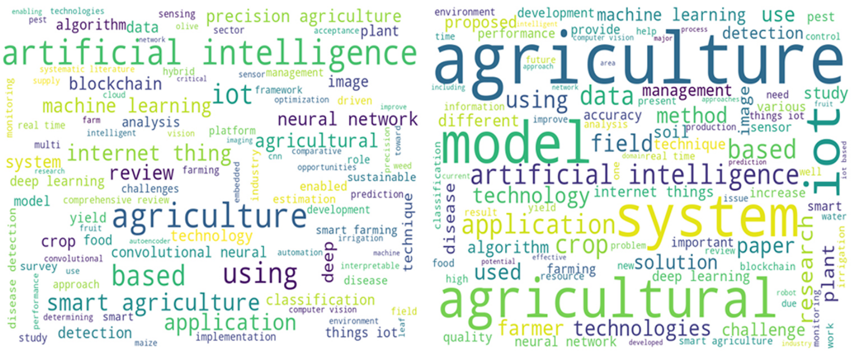

Figure 4. Word cloud of Abstract (left side) and Title (right side)
Source: Own Work

Step 4: Word clouds [68] [69] are a straightforward textual analytical technique that is employed to easily access the most frequent words within a textual content. The size of the word directly represents the highest number of words repeated in the text. Similarly in the case of Figure 5, artificial intelligence and agriculture is the highest word repeated again and again in the collected dataset "title" column.

An N-gram is a series of N words, and N-gram modeling is used to determine the likelihood that a word or an N-gram will appear in the sequence after another one [70]. N-grams are an essential part of text mining and natural language analysis. It can be used to convert written language into data and to separate greater amounts of search data into more insightful chunks. Figures 5 and 6 represent the N-gram for "Abstract" and "Title" respectively.

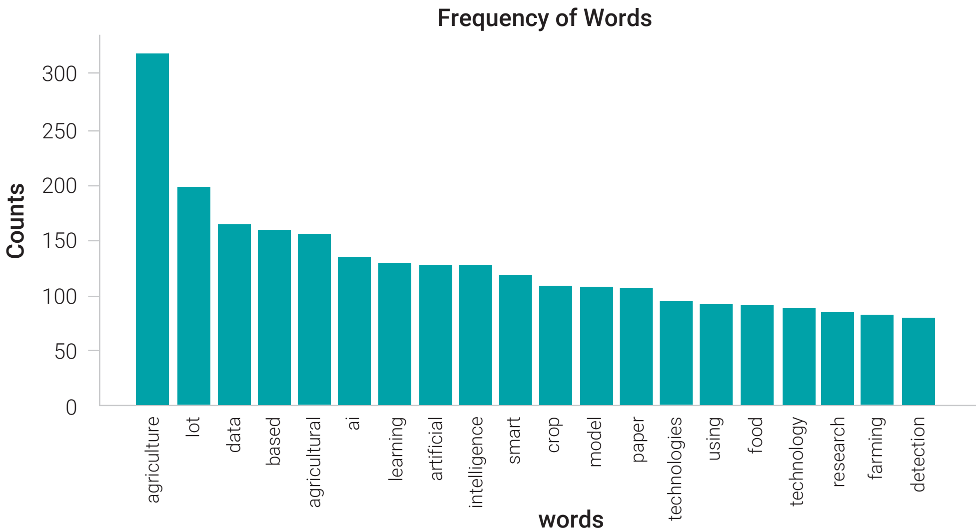

Figure 5. Frequency of words for the Abstract
Source: Own Work

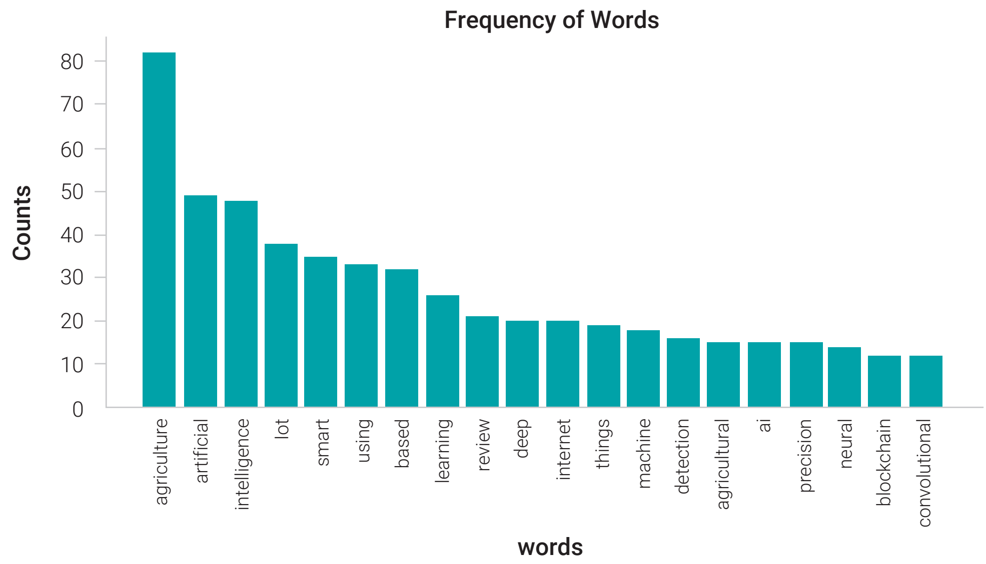

Figure 6. Frequency of words for the Title
Source: Own Work

4. OPEN ISSUES AND CHALLENGES

In this section, open issues and challenges are discussed and highlighted in Figure 7.

a) **Limited Dataset and Labeling:** Recognizing crop diseases is essential for maintaining the health and yield of crops. Yet, one of the major concerns in this field is the need for more high-quality information for AI algorithm training [71]. A few annotated images are available in the crop detection techniques because gathering the images for plant diseases is expensive and time-consuming [72]. As a result, some classes in the training process can only view a small number of annotated images.

b) **Variation in crop disease appearance:** The variety in plant appearance is an additional obstacle to the crop disease detection method. Because of genetic variations, environmental changes, and growth patterns, even plants of the same species can have a variety of appearances [73]. One species of plant, for instance, may have various leaf dimensions, tints, and patterns depending on its growth period, environment, and illumination. Due to this, it is challenging for automated systems to recognize and categorize these plants based on their looks.

c) **Limited Computation Power:** AI technology is a promising method to classify crop diseases at an early stage, improve the quality of food, and reduce the economic losses for the farmers. However, the devices' computation power creates hurdles for the AI algorithm to deploy the models on the embedded devices [74]. Low-power deep learning models can solve these issues using the knowledge distillation method [75]. Similarly, a deep learning model has been used to detect diseases in potatoes via skip connections [76]. Due to recent technological advancements in computing power, memory, and high-resolution displays, small gadgets can detect and identify crop diseases [71].

d) **Interpretability:** AI models have grown in popularity in recent years due to their high degree of data prediction accuracy. Nevertheless, one problem in this industry is the model's interpretability. AI models are usually considered "Black Boxes" [77] due to the lack of transparency in their prediction process, which makes it difficult to understand and conclude how the model arrived at a particular decision [78].

e) **Compatibility Issues**

IoT devices in agriculture confront several security issues, compatibility issues being one of them. Due to these problems, the farming system's device variability makes it challenging to create IoT frameworks that work together [79]. Several issues need to be addressed as follows:

- **Interrupted Cloud Connection:** One of the main problems with IoT in agriculture is lost access to centralized servers like the cloud, which are necessary for IoT systems. The leading cause of this interruption is the ecosystem's weak internet connectivity, which can be fixed with LoRaWAN and WisGate [80]. Disrupted connectivity also opens the door to criminal activity and cybersecurity danger.
- **Interoperability issues:** The interoperability of agricultural IoT devices is a significant barrier to the digitalization of farms due to expensive hardware resources and a need for modern agriculture solutions [81]. An interoperable IoT framework is needed to provide consistent and real-time plant conditions and environmental aspects in farms using various IoT devices [82].
- **Limited Resources:** The monitoring of agricultural fields, such as soil temperature, soil humidity, potassium, calcium and phosphorus, can be done in farming using resource-constrained sensor nodes such as sensors and low-cost power controllers [83]. These nodes are more

vulnerable since they have less memory, processing capacity, and less capacity for interdepartmental communication.

f) Lack of Devices Standardization

Lack of standards in the agriculture IoT field may result in less effectiveness, higher costs, and a lesser rate of creativity. There are some concerns as follows:

- **Standardized Coding:** Lack of standardized features, operating power, and communication protocols make it challenging to maintain the standardization of the terminology for agricultural IoT devices. It can create confusion and errors in the device's identification and operation.
- **Regulatory Barriers:** The standardization of compliance in agricultural IoT devices needs to be improved by the absence of precise regulatory requirements. Agriculture IoT devices have several regulatory barriers, such as product labelling, testing, certification, security standards, and user privacy [84].

g) Data Management

Data management is crucial for managing the sensor node and user data and making it easy for farmers to make decisions in any IoT ecosystem. It faces several concerns in agriculture, including:

- **Complications in data integration and connectivity:** Data integrations from different sources, such as environmental parameters, soil parameters and farm resources, can be complex because of different standards and protocols. This can create barriers to further data analysis and prediction [85] [86]. In rural areas, connectivity is also limited.
- **Lack of skills:** Farmers need high skills and resources to analyze and manage crop condition data through the sensors. Without the proper skills, it may lead to predictions or decisions being misinterpreted.

h) Adaptability

Technology adoption in agriculture encounters some organizational, societal, and technological challenges [87].

- **Technological:** The technological adaptability of IoT and AI includes weak connectivity, high hardware cost and availability of the data for model training [88]. Moreover, it also needs maintenance of the hardware resources and upgrading firmware and software for the system.
- **Societal and Organizational:** Pressures on agriculture from growing populations and urbanization increase are two examples of social

problems. Others include the difficulty of depending on family expertise and investor confidence issues [89].

i) **Environmental Factors**

Technology-enabled smart farming can advance the agriculture sector by providing the appropriate environmental conditions around the crops. There are environmental factors that can create hurdles in IoT and AI agriculture as follow: 1) Harsh environmental conditions, 2) Disrupted Connectivity.

5. ENABLING VARIOUS TECHNOLOGIES IN AGRICULTURE

In this section, the role of various applications in agriculture has been discussed as follows:

a) **Robotics**

In agriculture, robotics is essential, especially in managing and detecting crops diseases. The identification and location of individual plants using machine vision methods [90] have been used in agriculture for tasks including plant thinning, weeding, and variable fertilization of lettuce. Agriculture with precision is another way robotics are used in agriculture. Using sensors, GPS, and other technology, precision farming gathers information on the growth of crops, climate trends, and soil quality [91] [92].

b) **Drones**

According to research, Drones significantly impact agricultural and plant pathogen detection. Infectious illnesses and pests on farms can be found using remote-sensing devices like satellites and drones [93]. Farmers may more quickly detect plants afflicted by pests and diseases by deploying drones explicitly designed for agricultural purposes [2]. Plant leaf diseases have been detected using drones, which has proven very effective [94]. Drones have also been used to better understand how plant diseases move above agricultural fields [95]. Additionally, research has been performed to develop an autonomous drone for crop disease detection [96].

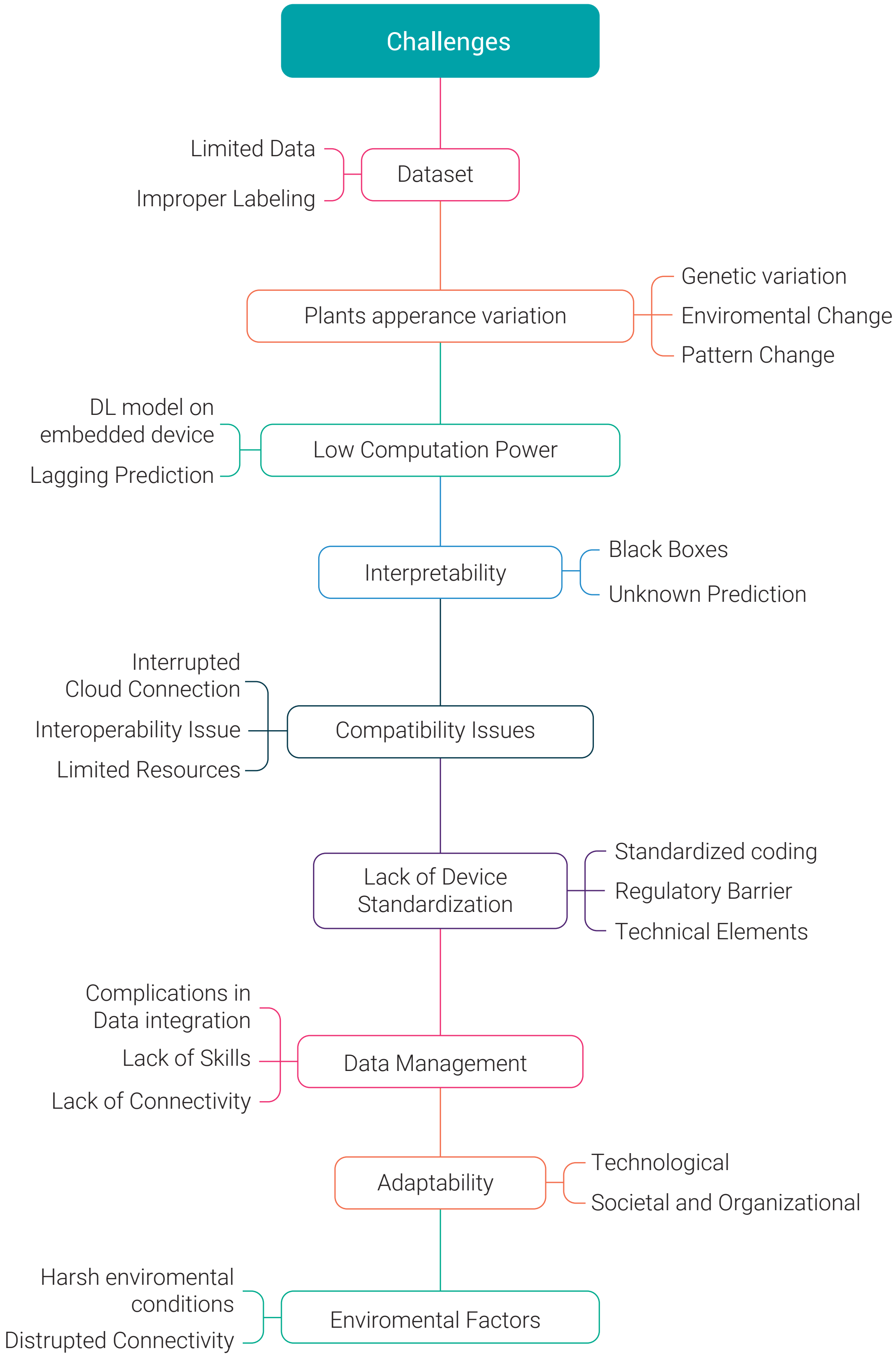

Figure 7. Open Issues and Challenges in agriculture and diseases detection system
Source: Own Work

Table 2. Studies highlight issues and challenges.

Studies	Limited Dataset and Labelling	Variation in dataset appearance	High Computation power	Interpretability	Compatibility Issues	Standardization	Adaptability
[71] [72]	✓	✗	✗	✗	✗	✗	✗
[73]	✗	✓	✗	✗	✗	✗	✗
[74] [75] [76]	✗	✗	✓	✗	✗	✗	✗
[77] [78]	✗	✗	✗	✓	✗	✗	✗
[80] [81] [82] [83]	✗	✗	✗	✗	✓	✗	✗
[85] [86]	✗	✗	✓	✗	✗	✓	✗
[87] [88] [89]	✗	✗	✗	✗	✗	✗	✓

c) Satellite Imaging

Satellite imaging is crucial in agricultural studies and the study of plant diseases. Various aspects of agriculture have benefited from using satellite data, including determining harvest timing, predicting seasonal yields, recognizing, and managing insects and diseases, recognizing water and nutrient status, developing crop nutrition plans, and making decisions about in-season irrigations [97]. A time-series set of satellite photos is often needed for continuous crop monitoring. Because the temporal and spatial detail of satellite images must be balanced, spatiotemporal image fusion (STIF) has been used to create time-series images at a constant scale [98] [99].

d) RFID

Around the world of agriculture, Radio Frequency Identification (RFID) sensing technology has become a new instrument with applications in monitoring plant health, the state of the soil, plant growth, and growing environments for plants [100]. Agrochemical development, leaf wetness detection, and plant health inspection and certification are some of the applications of RFID in plant health management [4][101][102]. RFID sensors may also track the levels of gases like acetaldehyde or ethylene and environmental parameters, including humidity, light, shock/vibration, pH, and shock/vibration. The use of biosensor tags to identify plant diseases is also being researched.

CONCLUSION

A vital aspect of agriculture is the early detection of crop illness because doing so can limit financial losses and diseases spreading across fields. Although agricultural professionals were involved in conventional methods, they occasionally overlooked problems that were visible to the human eye. Nowadays, crop diseases are identified using advanced technology. The majority of current solutions are centered on AI technology. While AI is able to detect crop diseases in the field, it can only do so for diseases and not for environmental factors. The fusion of AI and IoT technology enables the detection of changes in the environment surrounding crops, which aids in the early detection of any disease. The role of various technologies used in agricultural and crop disease detection is reviewed and analyzed in this paper. In order to build a study path for other researchers to understand the function of various technologies in crop disease detection approaches, a text mining method is applied to the data collected based on recent publications. Additionally, the difficulties in applying these strategies in the sphere of agriculture are highlighted by outstanding issues and obstacles. The main benefits of extracted keywords include understanding data structure, choosing valuable items for further processing, understanding context in text-based data, visualizing representations of keywords to construct narratives, and search engine optimization.

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