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Inscribing Big Data Issues Implementing Hadoop Technology

Dr. Dhaneswar Parida[1], Mr. Gopal Behera[2]*

[1] Professor,Dept. Of Computer Science and Engineering, NIT , BBSR*
[2]Assistant Professor,Dept. Of Computer Science and Engineering, NIT , BBSR

dhaneswarparida@thenalanda.com, gopalbehera@thenalanda.com*

Abstract

The dimension of the databases used in today's firms has been developing at exponential rates day via day. Simultaneously, the want to technique and analyze the large volumes of statistics for business selection making has additionally increased. In several business and scientific applications, there is a need to system terabytes of data in efficient manner on each day bases. This has contributed to the huge records trouble confronted with the aid of the industry due to the lack of ability of traditional database structures and software tools to manage or method the large records units within tolerable time limits. Processing of statistics can include more than a few operations depending on utilization like culling, tagging, highlighting, indexing, searching, faceting, and so forth operations. It is not possible for single or few machines to shop or process this large amount of statistics in a restricted time period. This paper reports the investigational effort on big data problem and its best solution using Hadoop cluster, Hadoop Distributed File System (HDFS) intended for storage and using parallel processing to process big data sets by Map Reduce programming framework. We have completed prototype implementation of Hadoop cluster, HDFS storage and Map decrease framework for giving out large data sets by allowing for prototype of big data application situations. The results attained from various experiments designate favorable results of beyond approach to tackle big data problem.

Index Terms-- Big Data Problem, Hadoop cluster, Hadoop Distributed File System, Parallel Processing, Map Reduce

I. INTRODUCTION

In this electronic age, increasing quantity of businesses are facing the hassle of explosion of data and the measurement of the databases used in today's organizations has been developing at exponential rates. Data is generated thru many sources like commercial enterprise processes, transactions, social networking sites, net servers, etc. and remains in structured as nicely as unstructured form [1]. Today's commercial enterprise purposes are having business enterprise facets like large scale, data-intensive, web-oriented and accessed from diverse gadgets including cell devices. Processing or inspecting the massive amount of information or extracting significant data is a difficult task.

I. BIG DATA

The idiom "Big data" is used for large data sets whose dimension is beyond the ability of frequently used software tools to capture, manage, and procedure the facts inside a bearable elapsed time. Big data sizes are a constantly transferring goal at present ranging from a few dozen terabytes to many petabytes of records in single documents set [2]. Difficulties consist of capture, storage, search, sharing, analytics and visualizing. Typical examples of huge data observed in present day situation consists of internet logs, RFID generated data, sensor networks, satellite and geo-spatial data, social data from social networks, Internet textual content and documents, Internet search indexing, call detail records, astronomy, atmospheric science, genomics, biogeochemical, biological, and special elaborate and/or interdisciplinary scientific research, navy surveillance, scientific records, photographs archives, video archives, and large-scale ecommerce. Big Data influences encompass Wal-Mart handles extra than 1 million shopper transactions every and every hour, which is imported into databases estimated to include greater than 2.5 pet bytes of records - the equivalent of 167 instances the data contained in all the books in the US Library of Congress, Face book handles 40 billion snap shots from its patron base and so on.

A. What is Big Data Problem?

Big Data has emerged due to the reality we are residing in a society which makes growing use of facts intensive technologies. One present day feature of large data is the venture working with it the use of relational databases and computer statistics/visualization packages, requiring as a replacement "massively parallel software program going for walks on tens, hundreds, or even heaps of servers"[3]. The extra than a few challenges faced in large data management consist of – scalability, unstructured data, accessibility, actual time analytics, fault tolerance and many more. In addition to variations in the extent of data saved in wonderful sectors, the kinds of data generated and stored—i.e., whether or not or not the information encodes video, images, audio, or text/numeric information—also fluctuate markedly from industry to industry[4].

B. Big data techniques and technologies

Big statistics requires extremely good utilized sciences to successfully manner giant portions of information within tolerable elapsed times. Technologies being utilized to big statistics encompass vastly parallel processing (MPP) databases, files mining grids, disbursed file systems, disbursed databases, and cloud computing platforms, the Internet, and scalable storage systems. Real or near-real time facts transport is one of the defining qualities of Big Data Analytics. Latency is consequently averted whenever and anywhere possible. A vast range of methods and applied sciences has been developed and adapted to aggregate, manipulate, analyze, and visualize large records [2].

These techniques and technologies draw from countless fields along with statistics, pc science, applied mathematics, and economics. This potential that an agency that intends to derive price from big statistics has to assume a flexible, multidisciplinary approach.

C. Hadoop [5]

The project Apache Hadoop expands open-source software for consistent, scalable and distributed calculations. The Apache Hadoop software library is a scaffold that allows athwart clusters of computers using an easy programming model for distributed dispensing of large data sets. It allows submissions to work with thousands of autonomous computational computers and pet bytes of data.. Hadoop was subsequent since Google's Map Reduce and Google File System (GFS).

D. HDFS (Hadoop Distributed File System) [5]

The Hadoop Distributed File System (HDFS) is a distributed file system that provides fault tolerance and is designed to run from resources on hardware. HDFS provides high data access throughput and is suitable for Big Data Set applications. Hadoop provides a distributed filesystem (HDFS) that can store data across thousands of servers, along with a workflow (Map / Reduce jobs) athwart those computers, running the work slam to the data. HDFS has software in favor of master / slave use. Big data is repeatedly split into chunks in the hadoop cluster which are griped by specific nodes.

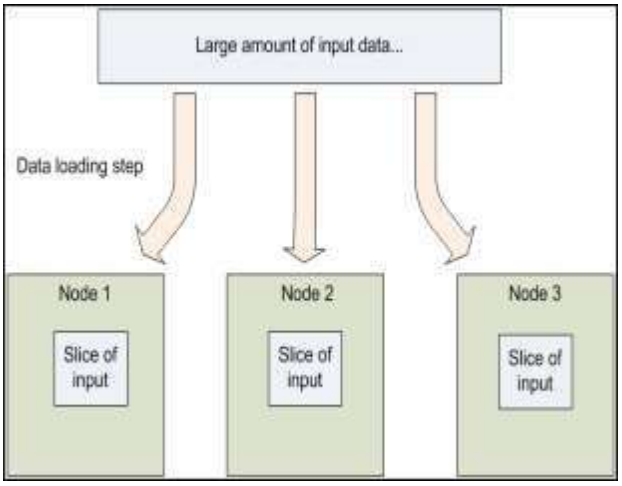


Figure 1: Data is distributed across nodes at load time

E. MapReduce Programming Framework

MapReduce is a software system that Google launched in 2004 to support distributed computation on computer clusters on large data sets. MapReduce is a tool for programmation for processing and generating big data sets. Users specify a map function that practice a key/value pair to spawn a set of intermediate key/value pairs and a diminish function that merges all intermediate values connected with the equivalent intermediate key [7].

"Map" step: The master node takes the data, splits it into smaller sub-problems and distributes it to the nodes of the worker. In addition, a worker node could do this again, leading to a multi-level tree structure. The worker node handles the minor issue and returns the answer to its master node. Map takes one pair of data in one data domain, with one kind, and proceeds a list of pairs in a dissimilar domain:

"Reduce"step:

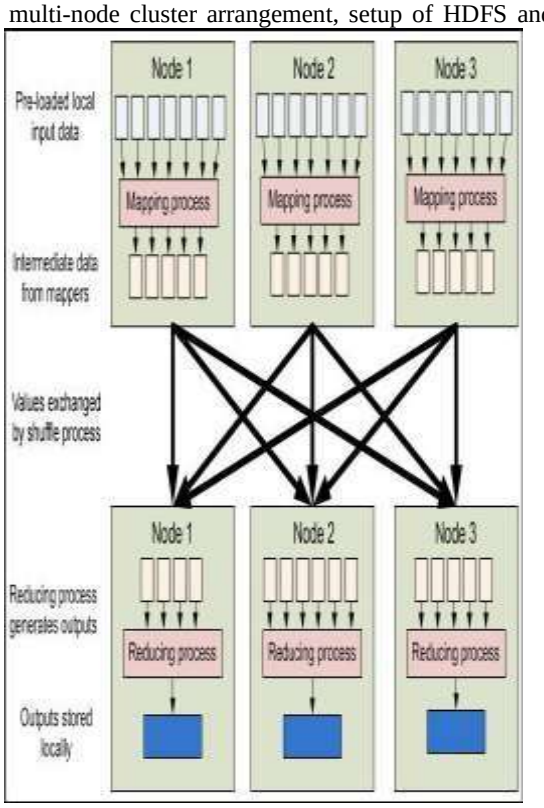
The master node then gathers the answers to all of the sub-problems and combines them to form the output in some way, th e answer to the problem it originally tried to solve.

The Reduce function is then applied in parallel with each group, resulting in a collection of values in the same domain: Reduce (K2, list (v2)) → list (v3)

Figure 2: Distributed Map and Reduce processes

III. SYSTEM ARCHITECTURE

The system architecture encompasses of hadoop architecture, hadoop multi-node cluster arrangement, setup of HDFS and



accomplishment of Map Reduce programming work to resolve the data rigorous problem.

A. HDFS Architecture

As show in Figure 3, an HDFS cluster comprises of a single NameNode, a master server that supervise the file system namespace and regulates access to files by clients. Additionally, there are a number of Data Nodes in the cluster, normally one per node, that manage storage attached to the nodes they run on. HDFS provides a namespace for the filesystem and allows user data to be stored in folders. Internally, a file is divided into one or more blocks, and those blocks are stored in a Data Node set. Name Node determines Block mapping to Data Nodes. HDFS is intended to reliably hoard very large files athwart machines in a huge cluster. It stores every file as a series of blocks.

B. Hadoop Cluster High Level Architecture

Hadoop cluster consists of a one master and several slaves or "worker nodes".In Hadoop,The JobTracker is the service that farms MapReduce tasks to specific nodes in the cluster, preferably nodes that have the data, or at least are in the similar rack.

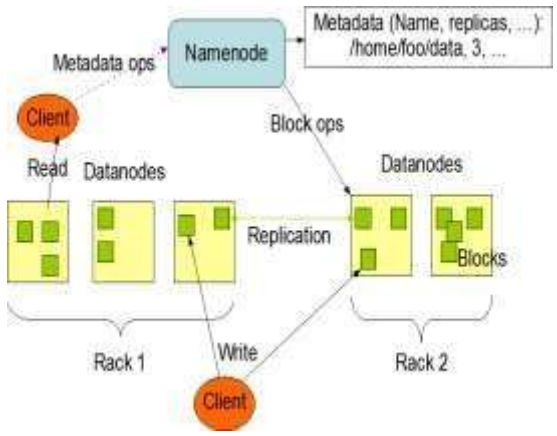


Figure 3: HDFS Architecture

A Task Tracker is a node in the cluster that accepts duties - Map, Reduce and Shuffle operations - from a Job Tracker. The master node consists of a Job Tracker, Task Tracker, Name Node, and Data Node. A slave or employee node acts as both a Data Node and Task Tracker. In a large cluster, the HDFS is managed thru a devoted Name Node server to host the file machine index, and a secondary Name Node that can generate snapshots of the title node's memory two structures, for this reason preventing file device corruption and lowering loss of data.

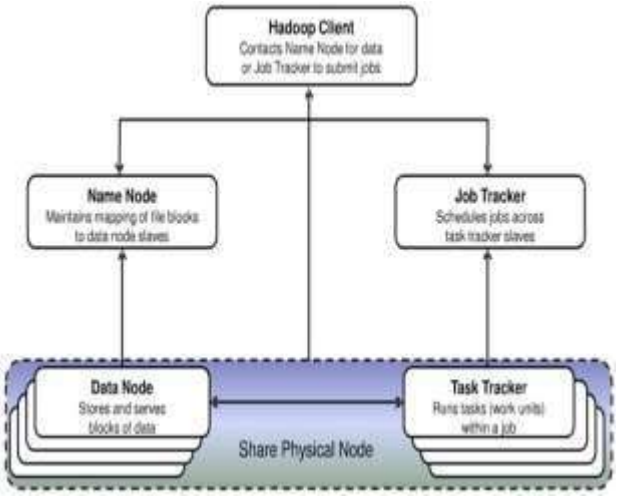


Figure 4: Hadoop high-level architecture

II. EXPERIMENTAL SETUP

For playing out the large information tests, arrangement of Hadoop information group including four hubs and Hadoop Distributed File System (HDFS) for capacity was utilized. Before moving to multi-hub group, single hub bunch was first designed and tried. Hadoop has an excessive number of design parameters to depict here, however the most applicable with the end goal of this assessment is the quantity of simultaneous Map and Reduce undertakings that are permitted to run on every hub. We designed our group to run eight simultaneous errands for each server. Each Map/Reduce program that is run is divided into map undertakings and diminish errands. Information and yield information for the Map/Reduce programs is put away in HDFS, while information and yield information for the information equal stack-put together execution is put away straightforwardly with respect to the neighborhood plates. One hub was arranged as Master hub and different hubs were assigned as slave hubs. The ace hub runs the "ace" daemons: Name Node for the HDFS stockpiling layer and Job Tracker for the Map Reduce handling layer. The slave hubs run the "slave" daemons: DataNode for the HDFS layer and Task Tracker for Map Reduce preparing layer.

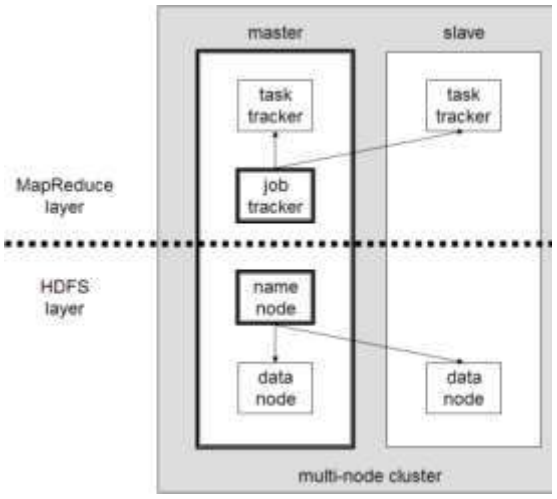


Figure 5: Hadoop multi-node cluster setup

IV. EXPERIMENT AND RESULTS

A. Text processing application

The initial experiment was text dispensation word count research to count the amount of words that transpire within a set of large sized credentials. The map function gash each document interested in words and outputs every word together with the digit "1." The output records are consequently of the form (word, 1). The Map Reduce structure groups all the records with the similar key (i.e., word) and feeds them into the diminish function. The reduce function sums the input values and outputs the word and the total amount of incidence in the document(s).

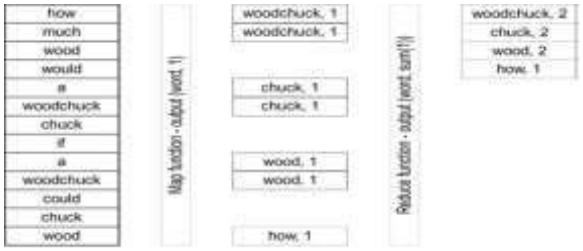


Figure 6: Map Reduce for word count

1) Experiment with augment in number of nodes

Dataset: Size of files used = 100 Mb

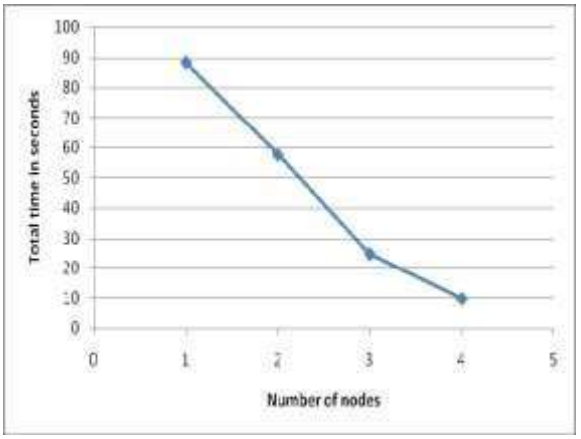


Figure 7: Execution time with varying number of nodes

2) Experiment with enlarge in size of dataset and nodes

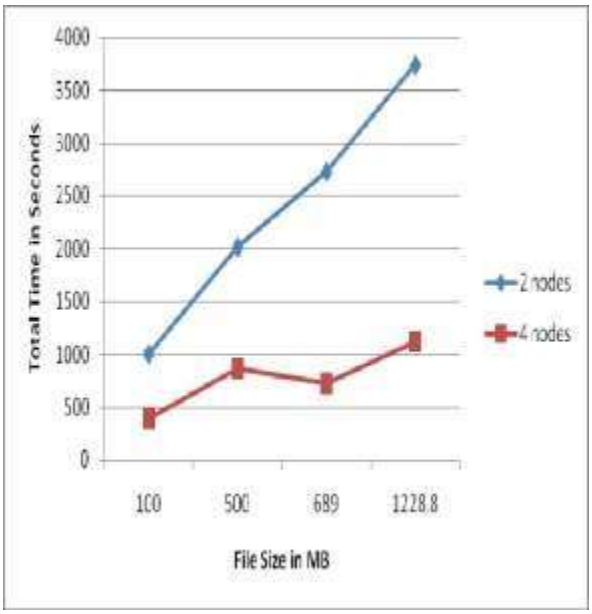


Figure 8: Execution time with varying dataset and nodes

The above consequence specify the execution time diminishes with amplify in number of nodes worn in Hadoop cluster.

B. Earthquake Data Analysis

In the subsequent trial, we have examined the earth shake information distributed by U.S. Land Survey (USLS). The earth tremor information is accessible as CSV (comma-isolated qualities) records distributed at occasional interims. The investigation of earth shake information gives answer to where the seismic tremors happened by area, number of earth shudders on specific date.

IV. CONCLUSION AND FUTURE WORK

In this work, we have investigated the answer for enormous information issue utilizing Hadoop information group HDFS and Map Reduce programming structure utilizing large information model application situations. The outcomes acquired from different tests show positive aftereffects of above way to deal with address huge information issue. Future work will concentrate on execution assessment and displaying of hadoop information serious applications on cloud stages like Amazon Elastic Compute Cloud (EC2).

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Artificial Intelligence (AI) is a key area of computer science research. With its rapid technological advancement and wide range of applications, AI is very rapidly becoming omnipresent due to its robust applicability in particular problems that cannot be well solved by humans and traditional computer structures[1]. Such an area of extreme importance is agriculture where approximately 30.7 per cent of the world's population is directly engaged on 2781 million hectares of farmland. Such a venture does not run so smoothly, it faces several challenges from sowing to harvesting. The major issues are pest and disease infestation, inadequate application of chemicals, improper drainage and irrigation, weed control, yield prediction, etc.

Agriculture is the bedrock of sustainability of any financial system [1]. It plays a key part in long time period economic boom and structural transformation [2-4], though, may also fluctuate through nations [5]. In the past, agricultural things to do have been restricted to food and crop production [6]. But in the ultimate two decades, it has evolved to processing, production, marketing, and distribution of vegetation and livestock products. Currently, agricultural things to do serve as the basic source of livelihood, improving GDP [7], being a supply of countrywide trade, reducing unemployment, offering uncooked substances for production in different industries, and basic increase the economy

The utility of computers in agriculture was first suggested in 1983 [2]. Different tactics have been suggested to remedy the current troubles in the agriculture starting from the database [3] to selection help structures [4]. Out of these solutions, structures that apply AI have been located to be the most outstanding performers as far as the accuracy and robustness are concerned. Agriculture is a dynamic domain the place situations cannot be generalized to advise a common solution. AI techniques have enabled us to capture the complicated details of each scenario and furnish a solution that is satisfactory fit for that unique problem. Gradually very complex troubles are being solved with the improvement of quite number AI techniques. It covers a hundred essential contributions the place AI methods were employed to encounter the challenges in agriculture. Three primary AI techniques; Expert Systems, Artificial Neural Networks and Fuzzy systems are regarded as the focused areas. This paper addresses the software of AI methods in the fundamental sub domain of agriculture so that the readers are

able to capture the gradual development of agro-intelligent systems throughout last 34 years, from 1983 to 2017

II. GENERAL CROP MANAGEMENT

In general, crop management systems grant an interface for normal administration of vegetation overlaying each component of farming. The thinking of using AI method in crop management was once first proposed in 1985 by using McKinion and Lemmon in their paper "Expert Systems for Agriculture" [5]. Another corn crop safety professional device was once proposed through Boulanger in his doctoral Thesis [6]. In 1987, Roach et al. proposed an professional gadget POMME for management of apple plantation [7]. Stone and Toman got here up with an specialist device for cotton crop administration COTFLEX [8]. Another rule base professional device COMAX was formulated with the aid of Lemmon for cotton crop administration [9].

A multi-layered feed ahead synthetic neural network based device was once formulated via Robinson and Mort to protect citrus plants from frost harm in Sicily island of Italy [10]. The enter and the output parameter(s) have been coded in binary form two to train and check the network. The authors used specific configurations of inputs to get a mannequin with the highest accuracy. The nice model so discovered had an accuracy of 94% with two output classes and six inputs. An photograph based AI approach used to be proposed with the aid of Li, S. K. et al., for wheat crop [11], by way of the usage of pixel labeling algorithm observed via Laplace transformation to make stronger the image information. The pleasant community received had 5 hidden layers trained up to 300000 iterations and had an accuracy of 85.9%.common sense primarily based soybean crop administration gadget used to be developed by using Prakash, C. et al. which furnished advices regarding crop selection, fertilizer utility and pest related troubles [12].

III. PEST MANAGEMENT

Insect pest infestation is one of the most alarming issues in agriculture that leads to heavy ecomonic losses. Over a long time researchers have tried to mitigate this threat through development of computerized structures that could pick out the lively pests and advocate control measures. Many rule based professional systems have been proposed which consists of Pasqual and Mansfield [13], SMARTSOY of Batchelor et al., [14-15], CORAC of Mozny et al. [16], Knight and Cammell [17], Mahaman et al. [18], Li et al. [19], Chakraborty et al. [20], and Ghosh [21]. The expertise concerned in agriculral administration is most of the times imperfect, vague and imprecise for this reason the rule base expert system can also lead to uncertainty. To capture this uncertainty, countless Fuzzy good judgment primarily based professional structures were proposed along with Saini et al. [22], Siraj and Arbaiy [23], Peixoto et al. [24], IPEST with the aid of Hayo et al. [25], Roussel et al. [26], Shi et al. [27], Jesus et al. [28]. An objected oriented method to body a rule base was taken with the aid of Ghosh et al., in creating TEAPEST, an specialist gadget for pest administration in tea [29]. Here additionally a segment by segment indentification and consultation system have been adopted. Later this device was once redesigned through Samanta and Ghosh with the aid of employing a multi-layered back propagation neural network [30] and then reformulated via Banerjee et al., by way of the use of radial basis function mannequin to reap greater classification charges [31].

IV. DISEASE MANAGEMENT

Crop ailments are also a count of grave difficulty to a farmer. Significant know-how and experience is required in order to notice an in poor health plant and to take quintessential steps for recovery. Computer aided systems are being used worldwide to

diagnose the diseases and to suggest manipulate measures. At very early stage, rule based systems had been developed which consists of Byod and Sun [32], Sarma et al., [33], Balleda et al. [34]. Tilva et al., proposed a fuzzy good judgment based totally mannequin to forecast illnesses primarily based on leaf wetness length [35].

Different synthetic neural network primarily based mannequin have been designed for disorder manage in different crops including; Francl and Panigrahi [36], Babu and Rao [37], Ismail et al. [38], Karmokar et al. [39], Sladojevic [40], Hanson et al.
[41] and Hahn et al. [42]. and Antonpoulos et al. [76]. Manek and Singh in contrast a quantity of neural community architectures in prediction of rainfall the usage of four atmospheric inputs.

IV. WEED MANAGEMENT

Some hybrid structures had been additionally suggested. Huang proposed an photograph processing model coupled with synthetic neural network mannequin to classify phalanopsis seedling diseases [43]. Sannakki et al.,
enforced a fuzzy good judgment strategy coupled with photo processing to detected share of contamination in leaf [44]. A machine the use of k-means segmentation algorithm used to be developed with the aid of Al-Hiary, et al. [45] and Bashish et al. [46]. Dr. Wheat is a web based totally expert gadget developed through Khan et al., for diagnosis of wheat diseases [47].

V. AGRICULTURAL PRODUCT MONITORING AND STORAGE CONTROL

Apart from pests and diseases monitoring, storage, drying, grading of harvested vegetation are also very vital components ofagriculture. This part addresses various food monitoring and great manage mechanisms that hire the thought of artificial intelligence. Several fuzzy logic based totally structures were designed, which consists of Kavdir et al. [48], Gottschalk et al. [49], and Escobar et al. [50]. The systems developed by using theusage of artificial neural networks are to be addresses such as Taki et al. [51], Yang [52], Nakano [53], Capizzi et al. [54], Melis et al. [55], Miranda and Castano [56], Perez et al., [57], Martynenko and Yang [58], Movagharnejad and Nikzad [59], Khazaei et al. [60], Higgins et al. [61], Chen and Yang [62] and Boniecki et al. [63].

VI. SOIL AND IRRIGATION MANAGEMENT

Issues pertaining to soil and irrigation management are very essential in agriculture. Improper irrigation and soil administration lead to crop loss and degraded quality. This part highlights some researches carried out in soil and irrigation administration assisted by using artificial clever techniques. Brats et al. [64] designed a rule based totally professional machine for assessment of the layout and overall performance of microirrigation system
s.
Sicat et al. [65] used farmers' know-how to model a fuzzy primarily based system to suggest crops depending on land suitability maps produced by using the fuzzy system. Other fuzzy based structures consist of Si et al. [66], Tremblay et al. [67]. Valdes-Vela et al. used a Takagi Sugeno Kang fuzzy inference machine to guess the stem water attainable of a plant based on meteorological and soil water satisfied records [68]. An synthetic neural community exceptionally primarily based device for estimation of soil moisture in paddy used to be designed through Arif et al. [69]. Other well-known systems the use of synthetic neural community for soil and irrigation consist of Broner and Comstock [70]. Song and He [71]. Zhai et al. [72], Patil et al. [73], Hinnell et al. [74], Junior et al. [75] [77]. This learns about determined that radial foundation characteristic neural networks feature quality in evaluation to other fashions. Application of herbicides has a direct implication on human fitness and surroundings as well. Modern AI strategies are being

applied to decrease the herbicide application via suited and particular weed management. Pasqual [78] designed a rule primarily based specialist gadget for figuring out and eliminating weed in crops like oats, barley, triticale and wheat. Burks et al. [79] used laptop vision with a again propagation skilled neural community to identify weeds of 5 wonderful species. Burks et al. [80] in contrast three different neural community models mainly lower back propagation, counter propagation and radial foundation characteristic primarily based model with the equal set of inputs as the previous paper and found that lower back propagation network performs quality with 97% accuracy. In another strategy with the aid of Shi et al., [81] used to be developed by the use of image analysis and neural network. The different works stated by way of Eddy et al. [82], Nebot et al. [83] and Barrero et al. [84] were very terrific.

VII. ACQUIESCE PREDICTION

The crop yield prediction is very really useful for marketing strategies and crop cost estimation. Moreover, in the age of precision agriculture analysis of applicable elements that at once consequences the yield can also be finished via prediction models. Liu et al. [85], used an artificial neural network model employing back propagation mastering algorithm to predict yield from the soil parameters. The other excellent works consist of Kaul et al. [86], Uno et al. [87], Ji et al.,[88], Zhang et al. [89], Russ et al. [90], Singh [91], Alvarez [92] and Rahaman and Bala [93]. Ehret et al. constructed a neural model for predicting tomato yield, boom and water use in a greenhouse environment [94]. Thongboonnak and Sarapirome experimented on logan yield in extraordinary districts of Thailand using neural networks [95]. In a exceptional approach, Pahlavan et al. used electricity output as a measure of yield for basil plant life in greenhouse [96]. The other vital lookup works focused on prediction of yield includes Khoshnevisan et al. [97], Nabavi-Pelesaraei et al. [98] and Soheili-Fard et al. [99]. In 2014, Dahikar and Rode proposed a neural mannequin for prediction of 7 one-of-a-kind crop yield the use of atmospheric inputs and fertilizer consumption [100].

CONCLUSIONS

This survey covers a hundred research articles posted in the discipline of software of AI methods in agriculture for the duration of final 34 years beginning from 1983 to 2017. A lot of works are left behind to be cited in this constrained space. Only some representatives are chosen to be addressed to cover the multidimensional approaches. This paper has been prepared to make it as informative as possible with details of a variety of AI strategies employed in agriculture. During the early 1980s and 1990s, the rule based professional structures were extensively used whereas from 1990 onwards, artificial neural community fashions and fuzzy inference structures have taken the dominant role. In current years an uprising use of hybrid structures such as neuro-fuzzy or picture processing coupled with artificial neural networks are being used. It moves toward extra automated and greater accurate structures that act on real time. Further researches are being performed with more superior equipment so that common agriculture can move toward precision agriculture with low value.

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