APPLICATION OF ARTIFICIAL INTELLIGENCEIN FUZZY LOGIC FOR CROP MANAGEMENT INAGRICULTURE

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Abstract

This paper provides a systematic implementation of th e techniques of artificial intelligence for agricultural crop man agement. Agriculture faces many challenges, such as disease a nd infestation of pests, unsuitable soil treatment, inadequate dr ainage and irrigation and many more. Such result in severe crop failure along with environmental hazards caused by excessive chemical use. Several researches were carried out to deal with these issues. With its robust learning capabilities, the fields of artificial intelligence have become a crucial technique for solving various agricultural related problems. Systems are being developed to assist the agricultural experts around the world in finding better solutions. The sector faces numerous challenges to optimize its production, including inadequate soilcare, disease and infestation of pests, big data requirements, low output and knowledge gap between farmers and technology.

In agriculture the main concept of AI is its versatility, high perf ormance, precision and cost. This paper presents a review of th e soil management, crop management, weed management and disease management applications.

Keywords— Artificial Intelligence; Agriculture; Fuzzy logic; Artificial Neural Networks

I. INTRODUCTION

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 approxi mately 30.7 per cent of the world's population is directly engaged on 2781 million hectares of farmland. Such a venture does not r un so smoothly, it faces several challenges from sowing to harve sting. 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 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 of agriculture. 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 the usage 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 systems.
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 model with the equal set of inputs as the previous paper and found that lower back propagation network performs quality with 97% accuracy. Inanother 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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