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Artificial Intelligence in Agriculture: A Literature Survey

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Abstract: This Agriculture plays an important role in our day to day life and sustains the existence of life in this planet. Application of Artificial Intelligence (AI) in this sector is clearly visible and is ever growing than before. Soil management, Crop management, Weeds management, Water management, Weather predictions are the crucial areas identified in Agriculture, to act on. Any impacts or distractions in these areas can pay way to disruptions economy growth. Expectations from industries and farmers are to provide a solution at less cost and effectively performing at scale. Robotics have been tested a lot in this field and have seen an improvement over the years. Automations are significant in Agriculture, so as to reduce the complexity and tedious human labour. Maximising the yield with high quality and lesser chemical influence, have been the hopes from consumer perspective. Such an application of AI in Agriculture, will prevent lives from natural disasters, can alert or warn about the calamities and take the safest route.

Index Terms **- Artificial Intelligence, Agriculture, ML, Automation, Sensors.**

I. INTRODUCTION

Agriculture is the solid base to keep the economy alive and healthy [1]. The data has become digital now and it is as huge as it needs large storage areas like big data. Cloud service providers do provide such services which helps to store, scan, analyse, interpret, visualise and take successful decisions [2]. In 1983, Computers were applied in the field of Agriculture, for the first time ever [3]. Multiple solutions were recommended to identify and solve the existing issues in the field of Agriculture back then, all initiated from Database [4]. Later on, extended support is introduced with the help of decision support systems [5]. Despite Robots are lending extra support to make the works ease out, to bring in Robots into Agriculture domain was quite challenging to backend engineers and Scientists. Few of the robots were meant to be of limited use, so it had to be a case where complex tasks were broken down into simpler ones. However, with the invention of multi-purpose robots. At present, agricultural pursuits serve as the foundational source of livelihood, improving GDP [6], being a source of world-wide trade, Minimising unemployment, poverty, hard labour, raw materials for other machinery and industries and eventually develop the economy [7-9]. Agriculture involves a sequential flow of process which includes sowing seeds, planting, weeding out, spraying fertilizers, harvesting, etc. When AI technologies are applied as needed in each of these step, this process can turn out to be smoother and functions flexibly. The article covers 30 significant contributions which implemented AI, Automations from multiple facets.

II. LITERATURE SURVEY

1.1 Crop Management

Whole bunch of Agriculture practices will eventually end up in effective crop yields, for which Crop management sector came into picture. This will further depend on the type of crops, seasons of adaptation. McKinion and Lemmon first proposed the idea of implementing AI techniques in Crop management in 1985 [10]. Multiple farming techniques were engaged with a focus towards managing chemical, biological and environments for the crops with both qualitative and quantitative targets [11]. Crop recognition has gained considerable amount of traction in several scientific fields such as botanical gardens and species discovery. Different species can be identified and classified through the analysis of various parts such as seeds, roots, stems, flowers, leaves and fruits. Leaf based plant recognition seems to be most generic approach in investigating leaf's characteristics such as texture, shape and color [12]. Crop quality is more essential from the market perspective, and it is highly dependent on climate conditions, soil strength, cultivation practices and characteristics of crops. Agricultural products with higher quality has better selling price and value. When we consider Fruits quality, firmness and skin color are the parameters utilized for harvesting [13]. Farmers can merge various alternatives and strategies to survive water deficit crisis. Timing, magnitude and forecasting droughts are the important features to choose among alternatives [14]. AI usage in harvesting comprises of hardware and software components, sensors, vision detection systems, 3D imaging and a control scheme for the manipulator.

1.2 Pest Management

Insect pest infiltration has been daunting problem since ancient days. It is very hard to predict the infection, the source and the path of spread. AI based computerized systems can help in mitigating this risk of failure. Few rule based systems were recommended which includes one from Ghosh [15]. An expert system specifically for tea plantation was developed by Ghosh,

which is object oriented [16]. Diseases may be aggravated if the pest and its infections are not identified timely. Traditionally humans handle pest management in various ways which includes weeds, rodents and insects prevention through manual processes. Chemical pesticides have given a significant impact in eradicating pests easily, while bringing along health hazards. Meticulous measures are in place to ensure that health is not compromised with the way pesticides are evolved and used.

1.3 Disease Management

Diseases are also an important matter of concern to the industries and farmers. Computerized AI systems are used to find the sick plants earlier and suggest control measures to bring back the ailing plants to strength through recovery. Multiple neural network based artificial models have been proposed to control diseases [17-19]. The models typically depends on crops and weather conditions. To effectively manage and control diseases, a farmer has to embrace chemical, physical and biological measure [20]. However, accomplishing this is not easy and it consumes more time and cost [21]. Computer Vision Systems and Genetic Algorithm techniques can work at high speed and do multi-task, hence saving time and cost to an extent. Web-Based Intelligent Disease Diagnosis System (WIDDS) provides perfect accuracy and swift response to the nature of crop disease [22].

1.4 Weed Management

As seeds germinate and grow, weeds can grow along and spread out, draws all the minerals and energies which is needed for the plants. Hence, there can be a short of growth in plants and significantly impacts the growth of plants [23]. AI based services and ML algorithms with image recognitions can help to identify weeds precisely and apply herbicides only to the target zone instead of entire field [24] and project, analyse the shortest weeding path [25]. A study [26] substantiates that 50% reduction in yield for crops if weeds are not supervised over. Another report confirms that yields are drastically compromised to about 50% - 75% [27]. Above all of such scenarios, weeds can be of both productive and fatalistic effects to the ecosystem. Applying AI can monitor the weeds effectively and quickly. AI using Learning Vector Quantization has proven to provide high weed recognition rate in a short span of time.

1.5 Conclusion

This article has put together important yet minimal technologies facilitated by AI in various aspects of Agriculture. There are huge efforts which needs to be considered and factored in with evolving AI technologies. This article also provides factual information based on research and practical implementations of AI in agriculture domain. Available approaches to raise the standards, consumers of market commands high quality [28]. The UK agro-food chain generates over £100bn annually, yielding exports over £20bn in 2016 [29]. SVM have accomplished three most precise ML models in agriculture because of highly performing image processing techniques as its core advantage [30]. Further researches are happening with latest tools, models and technologies to achieve saving cost and intense labour with precision.

REFERENCES

[1] M. A. Kekane, “Indian agriculture-status, importance and role in Indian economy”, International Journal of Agriculture and Food Science Technology, Vol. 4, No. 4, pp. 343-346, 2013.

[2] Sonka, S. Big Data: Fueling the Next Evolution of Agricultural Innovation. J. Innov. Manag. 2016, 4, 114–136.

[3] D.N. Baker, J.R. Lambert, J.M. McKinion, ―GOSSYM: A simulator of cotton crop growth and yield,‖ Technical bulletin, Agricultural Experiment Station, South Carolina, USA, 1983.

[4] P. Martiniello, "Development of a database computer management system for retrieval on varietal field evaluation and plant breeding information in agriculture," Computers and electronics in agriculture, vol. 2 no. 3, pp. 183-192, 1988.

[5] K. W. Thorpe, R. L. Ridgway, R. E. Webb, "A computerized data management and decision support system for gypsy moth management in suburban parks," Computers and electronics in agriculture, vol. 6 no. 4, pp. 333-345, 1992.

[6] O. Oyakhilomen, R. G. Zibah, “Agricultural production and economic growth in Nigeria: Implication for rural poverty alleviation”, Quarterly Journal of International Agriculture, Vol. 53, No. 3, pp. 207-223, 2014

[7] T. O. Awokuse, “Does Agriculture Really Matter for Economic Growth in Developing Countries?”, The American Agricultural Economics Association Annual Meeting, Milwaukee, Newark, USA, July 28, 2009

[8] O. Badiene, Sustaining and Accelerating Africa’s Agricultural Growth Recovery in the Context of Changing Global Food Prices, IFPRI Policy Brief 9, 2008

[9] S. Block, C. Timmer, Agriculture and Economic Growth: Conceptual Issues and the Kenyan Experience, Harvard Institute for International Development, 1994

[10] H. Lemmon, "Comax: an expert system for cotton crop management,"Computer Science in Economics and Management, vol. 3 no. 2, pp. 177-185, 1990.

[11] Yvoz, S.; Petit, S.; Biju-Duval, L.; Cordeau, S. A framework to type crop management strategies within a production situation to improve the comprehension of weed communities. Eur. J. Agron. 2020, 115, 126009.

[12] Zhang, S.; Huang, W.; Huang, Y.; Zhang, C. Plant species recognition methods using leaf image: Overview. Neurocomputing 2020, 408, 246–272.

[13] Papageorgiou, E.I.; Aggelopoulou, K.; Gemtos, T.A.; Nanos, G.D. Development and Evaluation of a Fuzzy Inference System and a Neuro-Fuzzy Inference System for Grading Apple Quality. Appl. Artif. Intell. 2018, 32, 253–280.

[14] P. Debaeke, A. Aboudrare, “Adaptation of crop management to waterlimited environments”, European Journal of Agronomy, Vol. 21, No. 4, pp. 433-446, 2004

[15] I. Ghosh, ―An Artificial Intelligence Technique for Jute Insect Pests Identification,‖ Int. J. of dv. Research in Computer Science and Software Engineering, vol. 5 no. 11, pp.791-794, 2015.

[16] I. Ghosh and R. K. Samanta, "TEAPEST: An expert system for insect pest management in tea," Applied Engineering in Agriculture, vol. 19 no. 5, pp. 619, 2003.

[17] M. S. P. Babu, B. S. Rao, "Leaves recognition using back propagation neural network-advice for pest and disease control on crops." IndiaKisan. Net: Expert Advisory System (2007).

[18] B. C. Karmokar, et al., "Tea leaf diseases recognition using neural network ensemble," International Journal of Computer Applications, vol. 114 no.17, pp. 27-30, 2015.
[19] F. Hahn, I. Lopez, G. Hernandez, "Spectral detection and neural network discrimination of Rhizopus stolonifer spores on red tomatoes," Biosystems Engineering, vol. 89 no. 1, pp. 93-99, 2004.
[20] BEA, Value Added by Industry as a Percentage of Gross Domestic Product, available at: https://apps.bea.gov/iTable/iTable.cfm?ReqID=51&step=1#reqid=51&step=51&isuri=1&5114=a&5102=5, 2018
[21] Weed Science Society of America, Facts About Weeds, available at: http://wssa.net/wp-content/uploads/WSSA-Fact-SheetFinal.pdf
[22] S. Kolhe, R. Kamal, H. S. Saini, G. K. Gupta, "A web-based intelligent disease-diagnosis system using a new fuzzy-logic based approach for drawing the interferences in crops", Computers and Electronics in Agriculture, Vol. 76, No. 1, pp. 16-27, 2011
[23] Su, W.-H. Advanced Machine Learning in Point Spectroscopy, RGB- and Hyperspectral-Imaging for Automatic Discriminations of Crops and Weeds: A Review. Smart Cities 2020, 3, 767–792.
[24] Slaughter, D.C.; Giles, D.K.; Downey, D. Autonomous robotic weed control systems: A review. Comput. Electron. Agric. 2008, 61, 63–78. [Google Scholar] [CrossRef]
[25] Zhang, L.; Li, R.; Li, Z.; Meng, Y.; Liang, J.; Fu, L.; Jin, X.; Li, S. A Quadratic Traversal Algorithm of Shortest Weeding Path Planning for Agricultural Mobile Robots in Cornfield. J. Robot. 2021, 2021, 6633139. [Google Scholar] [CrossRef]
[26] K. N. Harker, "Survey of yield losses due to weeds in central Alberta", Canadian Journal of Plant Science, Vol. 81, No. 2, pp. 339–342, 2001
[27] T. Mruthul, Chemical weed management in sesame (Sesamum indicum L.), MSc Thesis, College of Agriculture, Raichur, University of Agricultural Sciences, 2015
[28] D. G. Panpatte, Artificial Intelligence in Agriculture: An Emerging Era of Research, Anand Agricultural University, 2018
[29] T. Duckett, S. Pearson, S. Blackmore, B. Grieve, Agricultural Robotics: The Future of Robotic Agriculture, UK-RAS, 2018
[30] Chandra, M.A.; Bedi, S.S. Survey on SVM and their application in image classification. Int. J. Inf. Technol. 2018.