Application of fuzzy combined SVM & graph theory for agriculture productivity prediction

Gunasekaran Prabakaran¹, Dhandapani Vaithiyanathan² and Madhavi Ganesan³

¹Department of Electronics and Communication Engineering, College of Engineering Guindy, Anna University, Chennai-25, India
²Department of Electronics and Communication Engineering, National Institute of Technology Delhi, India
³Centre for Water Resources, College of Engineering Guindy, Anna University, Chennai-25.

Abstract: A fuzzy integrated support vector machine and graph theory concepts are representations of data models for predicting a production. On this account, it has been used in various platforms such as agriculture, medicine, and various engineering applications. Therefore, the development of new computational development for predicting the productivity of events in terms of farming structure is very significant in agriculture. This method used fuzzy integrated support vector machine and graph theory to perform structural tasks suggested by crop influencing factors. Finally, the results obtained illustrate the advantage of predicting the rate of productivity, in addition to the importance of system recommendations that fail to produce the expected output volume at the time of setup or fail to produce the expected output quantum.

Keywords: Fuzzy, Support Vector Machine, Graph Theory, Agriculture, Productivity Prediction

1. INTRODUCTION

Determination of the crop productivity of agriculture based on the structures in the mainstream is one of the unavoidable steps of computational agriculture. Despite this, all the modifications of main structure on the subject are too closely relate to the propriety of factors deciding units and some determining factors. Productivity determination is a crucial element of agriculture and crop production research [1]. Improved productivity prediction models aim to provide accurate productivity for earlier diagnosis and security purposes [2]. For instance for food security and its significance is an important or indispensable function of Indian scenarios. Due to the increased density of population, there has been an urgency to build the system for to achieving the agricultural essential crop productivity and management. Earlier determination of system design and productivity prediction models design was required many analysis processes; even it has needs several operations in prediction measurements functions. Traditionally agricultural data us modeled using logistic process and method has been consisting multiple difficulties in a fitting to build the prediction system model. But fuzzy logic is useful here because they are not conducive to obtaining sufficient information such as productivity and forecasting. In such a way fuzzy logic together with the expert system, is involved in the process of agriculture land identification, soil formation, soil fertility, calculation of landslides and pesticide environmental impact determination [3] [4] [5] [6]. Hence, the fuzzy logic is in use in many quantitative decision analysis tasks based on natural phenomena [7]. Alternatively, SVM is an ideal approach because it enables the modern machine learning process to play a critical role, including parameters or length determining factors [8].
In each and every level of SVM process, n-dimensional factors and n-1 dimensional factors separating hyper plane structure were participants for fixing the distance and maximizing the SVM hyper plane structure units on each level. An appropriate kernel functions have been shortlisted for to enhancing the SVM overall activity. In prior to that, many of the previous research demonstrates has only to concluded minimum parameters used FIS system design in agriculture [9] [10]. Besides, to operate all level of parameter especially in line with predicting the agricultural productivity has multi-level of functions and apart from that, the complexity of system computation above are poor [11]. In addition to avoiding such a technical shortfall, it has been found graph theory approach operations for dealing all the level of functions is ease. Despite, graph theory was provides sufficient technology supports system complexity functions are remains challenging. Always graph theory concepts were been provided the major advantages of structuring the data, storing the data and exchanging the data. Likewise, many areas have been influenced by graph theory concept, very particularly which can be used social, technological platform and some biological networks, engineering applications and various database units [12] [13] [14] [15]. Apart from that graph theory concepts also offers suitable solutions in agriculture [16]. Beyond this, Implementation of fuzzy combined support vector machine and graph theory concepts could help provides a development in all the technical core problems. To solve such an issue, combing the SVM and graph theory concepts provides huge margin level of productivity pitches in output productivity prediction [17] [18]. Especially, a fuzzy combined support vector machine is a widely used procedure and commercially available technique for to predicting the productivity of all science properties issues including physics, chemistry, and biology [19] [20] [21]. Likewise, there are numerous applications has been published by previous researches. Similarly, the technology fuzzy and others have been appointed at the valid technology to carry out various especially in agriculture such as modeling, geostatistics, enhancing the soil quality. Not only that but with the principle of mapping and the use of social networks, the resource conservation of farming organization has been established and it been proves one of the most effective system for agriculture. Similarly, based on map theory, the major elements of agriculture have been analyzed in a broader tradition, and have achieved significant growth. Hence, this research work has addressing the difficulty which is has been used to determine the productivity influenced factors of agriculture management.

2. METHODS AND MATERIALS

Data from (2013-2016) were obtained from CWR, Anna University, through NADP-National Agricultural Development Programme for improving the socioeconomic factor of farmers. A crop influenced productivity factors that had been suggested by their peasants and core professional experts. Once imputing missing data also possible here, so that the analysis of dataset included much scrutiny process involved which is classified as having peasants involved agriculture (or) peasants are not involved into agriculture. In line with that in this research work, the selected potential crop influenced variables considered based on the conceptual model included nutrient factors, pest incidence, and other influenced factors. After segregating the several practices the data sets included a sample of selected ACZ of TamilNadu.

3. SUPPORT VECTOR MACHINE

The results of the multi-level decision support system cannot be overcome with a non-modern approach, therefore a best way is to treat each of the data to individuals and learn them through the first and second steps. This result unfortunately rarely results in the desired combination of the system. For instance, the DSS methods are accessed where they follow [22]. At the beginning of this line, we built a support vector machine approach where all data set variables are built-in from 1 to 1. Secondly to evaluate data sets labeled +1 from one decision support system data points to another - 1. Similarly, the support vector machine first divides the binary classes to increase the margin criteria,
which is particularly involved in the real-world problem. Therefore the support vector machine divides the hyper plane between the machine variables and extends the maximum of the edge criterion.

4. FUZZY COMBINED SVM

There are many real-time data variables in the world with high levels of noise and external models [23]. For those reasons, an SVM concept is used to regulate variable variants when training datasets for specific events. Therefore, if we consider SVM concepts as real-time variables, it does not provide adequate leverage, so it is inevitable to associate ambiguity with SVM [24] [25] [26]. Accordingly, fuzzy integrated SVM was obtained and finally, it was used in problems.

5. FUZZY COMBINED SVM AND GRAPH THEORY

The concept of fuzzy integrated graph theory has been used successfully in dealing with model uncertainty and ambiguity at different sites of the real model problem. Real-world problems due to large range of events, technology void issues could not be solved. Therefore, many technological improvements have been initiated and partially overcome. However, many more real-time problems remain unresolved. According to that concern, a field of technology does not entertain the entire problem as a single coordinated attack force, which helps achieve the goal. Accordingly, the integral fuzzy set theory, support vector machine, and graph theory are a final possibility for many unresolved and complex tasks. Graph theory is one of the primary concept and it has been used to solving the more complex real-time applications in various diversifications. Likewise here also the graph theory has been adopted for predicting the productivity in agriculture. The generalized task handling operation of graph theory process is explained below. A well-collected model of land-profile agronomic data makes it natural to predict agricultural outputs due to unusual and readily available units. In this case, there is a way to compensate for the differences between the behavior of the natural system and the crop influenced factors commitment to establishing the productivity of the crop without affecting any of its influencing factors. That is possible because of the influence of crop factors and the tendency for computer development under the advice of key professionals. Real-time agricultural data has 24 factors, where each data is slightly separated and varied from land to land [27]. Soil conditions are considered important for agricultural decision making [28]. There is an imperative to improve the quality of decision-making by making effective positioning predictions important. Many different data have the same density of fixed-length agricultural land because it provides a better predictor of crop productivity. Therefore, a DSS method designed to predict such productivity has already been tested using these data set variables, thus providing a good basis for comparison. In that place alone we had faced might difficulties to quick the system output prediction level as well as to increase the system speed.

6. RESULTS AND DISCUSSIONS

Initially, the extraction of crop influencing factors were been carried in from various crop influencing divergence such as primary nutrient, secondary nutrient, micronutrient, climate conditions, pest incidence occurrence possibilities, water variables, soil variables. The standard basis for which the crop can be grown and its conditions are kept in the crop database. The form was retrieved using the design and built land profile information. This is done by crop map theory methods that need to be synchronized, and the support vector machine is coupled to fuzzy logic. All of this is done through the main control methods of graph theory. This is done in conjunction with the support vector machine and fuzzy logic, followed by graph theory and the support vector machine combined with fuzzy logic. In this case, each landscape is considered an example and is based on graph theory, support vector dynamics, and fuzzy logic, respectively. The work is implemented by using real-time land data values.
and nearly 100 land profiles. The research was carried by using 100 land profiles data and it’s observed that approach give better results when compared to the brute force-based approach. It clearly visualized that the support vector machines and fuzzy combined approach in terms of productivity have been showcased their valuable outputs. The quality of the fuzzy combined support vector machine and graph theory system captured the same trends and with different evaluation factors. In newly methodology adopted models are based on the concepts of SVM, fuzzy crisp values intervals and graph theory is designed and there will be no modification changes on the output values. The fuzzy integrated support vector engine, fuzzy integrated graph theory, fuzzy integrated SVM and graph theory are listed in Table 1.

| Techniques                            | Sensitivity | Specificity | Accuracy |
|---------------------------------------|-------------|-------------|----------|
| FSVM                                  | 73.31       | 75.42       | 79.23    |
| Fuzzy combined graph theory           | 70.12       | 71.25       | 72.83    |
| Fuzzy Combined SVM & Graph theory     | 82.18       | 84.42       | 86.65    |

7. CONCLUSION

In this study fuzzy combined support vector machine graph theory concepts were used in agricultural production. Because the real land profile data set was so obscure since integrated methods were used to improve the performance of the system. In addition, an accounting-based new agricultural architecture system was developed and implemented in support of its design process. Finally the performance of the system with support vector values with respect to the land profile is obtained.

ACKNOWLEDGEMENT

The authors wish to acknowledge the financial supporters/ Government of India, Ministry of Agriculture and Farmer’s welfare for their work provided through the scheme of National Agriculture Development Programme as part of the Department of Agriculture and Plantation Crops, Government of TamilNadu in the project for much helpful discussions and implementations.

REFERENCES

[1]. Ashraf, M., Öztürk, M., Ahmad, M. S. A., &Aksoy, A. (Eds.). 2012. Crop production for agricultural improvement. Springer Science & Business Media.

[2]. Fan, M., Shen, J., Yuan, L., Jiang, R., Chen, X., Davies, W. J., & Zhang, F. 2012. Improving crop productivity and resource use efficiency to ensure food security and environmental quality in China. *Journal of experimental botany*, 63(1), 13-24.

[3]. Ejiofor C and Ugwu C 2015 Application of Support Vector Machine and Fuzzy Logic for Detecting and Identifying Liver Disorder in Patients. *IOSR Journal of Computer Engineering*, Volume 17, Issue 3, PP 50-53.

[4]. Souza, Fernando Basquiroto de, et al. A fuzzy logic-based expert system for substrate selection for soil construction in land reclamation. *REM-International Engineering Journal* 71.4 (2018): 553-559.

[5]. Ogunleye, G. O., Fashoto, S. G., Mashwama, P., Arekete, S. A., Olaniyan, O. M., & Omodunbi, B. A. 2018. Fuzzy Logic Tool to Forecast Soil Fertility in Nigeria. *The Scientific World Journal*

[6]. Roy, Jagabandhu, and Sunil Saha. 2019 Landslide susceptibility mapping using knowledge-driven statistical models in Darjeeling District, West Bengal, India." *Geo environmental Disasters* 6.1: 11.

[7]. Van Der Werf, Hayo MG, and Christophe Zimmer. 1998 An indicator of pesticide environmental impact based on a fuzzy expert system. *Chemosphere* 36.10: 2225-2249.
[8]. Awad, M., & Khanna, R. 2015. Support vector machines for classification. In Efficient Learning Machines (pp. 39-66). Apress, Berkeley, CA.

[9]. Bosma, R., Kaymak, U., Van den Berg, J., Udo, H., & Verrecht, J. 2011. Using fuzzy logic modelling to simulate farmers’ decision-making on diversification and integration in the Mekong Delta, Vietnam. Soft Computing, 15(2), 295-310.

[10]. El-Gayar, O. F., & Tandekar, K. 2006. An IDSS for Regional Aquaculture Planning. In Intelligent Decision-making Support Systems (pp. 199-218). Springer, London.

[11]. Marks, Leonie A., and Elizabeth G. Dunn. 2017. Fuzzy multiple attribute evaluation of agricultural systems. Using Multi-criteria Decision Analysis in Natural Resource Management. Rutledge. 135-158.

[12]. Gakh, A. A., Gakh, E. G., Smantper, B. G., & Noid, D. W. 1994. Neural network-graph theory approach to the prediction of the physical properties of organic compounds. Journal of Chemical Information and Computer Sciences, 34(4), 832-839.

[13]. Canutescu, Adrian A., Andrew A. Shelenkov, and Roland L. Dunbrack Jr. “A graph-theory algorithm for rapid protein side chain prediction. 2003 Protein science 12.9: 2001-2014.

[14]. Liu, H., Bai, L., Ma, X., Yu, W., & Xu, C. 2019. ProjFE: Prediction of fuzzy entity and relation for knowledge graph completion. Applied Soft Computing, 81, 105525.

[15]. Saila, Saol B. Application of fuzzy graph theory to successional analysis of a multispecies trawf fishery 1992. Transactions of the American Fisheries Society 121.2: 211-233.

[16]. Kannimuthu, S., Bhanu, D., & Bhuvaneswari, K. S. 2020. A novel approach for agricultural decision making using graph coloring. SN Applied Sciences, 2(1), 31.

[17]. Rudd, Jessica M. Application of support vector machine modeling and graph theory metrics for disease classification 2018. Model Assisted Statistics and Applications 13.4: 341-349.

[18]. Erdelyi, E. 2006. Graph theory application for investigating agro-ecosystems effected by extreme weather conditions. Applied Ecology and Environmental Research, 4(2), 181-187.

[19]. Piao, G., Guo, J., Hu, T., Leung, H., & Deng, Y. 2019. Fast reconstruction of 3-D defect profile from MFL signals using key physics-based parameters and SVM. NDT & E International, 103, 26-38.

[20]. Ivanciu, O. 2007. Applications of support vector machines in chemistry. Reviews in computational chemistry. Reviews in computational chemistry. 23, 291.

[21]. Goodson, S. G., Zhang, Z., Tsuruta, J. K., Wang, W., & O'Brien, D. A. 2011. Classification of mouse sperm motility patterns using an automated multiclass support vector machines model. Biology of reproduction, 84(6), 1207-1215.

[22]. Çomak, E., Arslan, A., & Türkoğlu, İ. 2007. A decision support system based on support vector machines for diagnosis of the heart valve diseases. Computers in biology and Medicine, 37(1), 21-27.

[23]. Dzulkalnine, M. F., & Sallehuddin, R. 2019 Missing data imputation with fuzzy feature selection for diabetes dataset. SN Applied Sciences, 1(4), 362.

[24]. Yu, X., Liong, S. Y., & Babovic, V. 2004. EC-SVM approach for real-time hydrologic forecasting. Journal of Hydroinformatics, 6(3), 209-223.

[25]. Yu, R., & Abdel-Aty, M. 2013. Utilizing support vector machine in real-time crash risk evaluation. Accident Analysis & Prevention, 51, 252-259.

[26]. Ni, J., Zhang, C., & Yang, S. X. 2011. An adaptive approach based on KPCA and SVM for real-time fault diagnosis of HVCBs. IEEE Transactions on Power Delivery, 26(3), 1960-1971.

[27]. Prabakaran, G., Vaithiyanathan, D., & Ganesan, M. 2018. Fuzzy decision support system for improving the crop productivity and efficient use of fertilizers. Computers and electronics in agriculture, 150, 88-97.

[28]. Manderson, A., & Palmer, A. 2006. Soil information for agricultural decision making: a New Zealand perspective. Soil use and management, 22(4), 393-400.