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Crop Recommendation and its Optimal Pricing using ShopBot

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Abstract— **Agriculture is one of the biggest economic activities in India. Every year crops are yielded in different regions of the country. This paper proposes a move towards precision agriculture to increase the yield of crops, minimize the cost and automate the inputs for processing. To modernize the process of cultivating crops, data mining techniques for crop recommendation based on the climatic factors primarily rainfall, temperature and location are used. Fertilizers and seeds are mandatory commodities for farming and buying them in large quantities along with proper pricing are necessary. The activity of purchasing a commodity on E-commerce websites with optimal cost and quantity can be monotonous and often one loses out on commodities while browsing. With the increase in online shopping, ShopBot has proven beneficial for online consumer search. A ShopBot offers a minimal search cost as well as compares products from multiple websites. This provides an aspect of optimization in cultivating and purchasing the crop.**

Keywords— crop recommendation, data mining, web scraping, price comparison, ShopBot, optimisation

I. INTRODUCTION

As the population increases day by day, the food demand is getting higher. Climatic conditions are the backbone for cultivating the optimal crop. The internet technology is getting advanced daily, the businesses are getting digitized. Every business owns their website or mobile application to provide services to their clients. This paper is focused towards the use of technology for recommending crop from the current environmental conditions and comparing its price on different websites thereby presenting the farmer with the best possible commodity.

Precision agriculture is the inculcation of Information Technology (IT) into farming with a view to increase crop production. This paper discusses an approach to increase the health as well as production of crop in optimal quantity that accounts for higher profits in the long term. Abundance of data helps to find out insights for cultivation and mitigates the false positive rates for recommendation of crop. Processing inputs over the environmental data would help to enhance the traditional crop production rates. Agriculture industry would gain higher when data-driven approach is applied for farming.

One such approach is used in [1]. It proposed inculcation of big-data i.e. gathering useful information from huge data available and Internet of Technology (IoT) to enhance the currently existing solutions in the smart health domain. It aimed to find out the challenges which were delaying the access to health-care by adopting smart solutions. According to [2], the scholar at Tufts University proposed that the farming practices in conjunction with technology could generate $2.3 trillion in cost savings and business opportunities annually out of which $250 billion accounts for data analytics.

Next, the paper discusses the time spent while searching on a website. This is known as search cost. As this cost increases, the users tend to search lesser among the few options available. Thus, the user is refrained from accessing all the possible commodities for a qualitative and quantitative product. Now, if the search cost is reduced, its adverse effects are price conflicts. This can be revamped with the use of ShopBot, which is a type of web crawler. A web crawler is a computer program which is an effective way for extracting data from the website. ShopBot is a virtual product search engine for providing commodity related details. ShopBot increases the substitute options for a commodity. They are on click services to get information about product and price from various sellers.

In paper[3],predicted in 2009 that the value of ShopBot would be higher shortly with the increase in search cost over the Internet. Nowadays, ShopBot also acts as an Enterprise Software (ES) for organizations that aim to provide a comparison for their desired area of interest. [4] discusses ES as a system which can lead the organization with exceeded budgets and minimum returns if they fail to understand the legal technicalities associated with it. The paper identified the critical success factors (CSFs) in the acquisition of ES to avoid the mistakes and risks associated with its contract.

II. LITERATURE SURVEY

The survey performed gave a deeper understanding of the subject and clarified concepts regarding crop recommendation, web scraping and price comparison.

Paper[5] aims to develop a website for finding out the impact of parameters of climate on crop production in particular places. The predominant crops are selected in this study. This paper considered various parameters namely rainfall, maximum and minimum temperature, and soil quality. The technique adopted here proposes the first child whose value is above the threshold and categorizes the others as another child.

The decision tree has been used for forecasting the crop yield. [6] implemented a recommendation system for crop selection depending upon the soil type, rainfall and temperature. The paper used soil dataset and input dataset. The datasets are preprocessed by handling the missing values thus normalizing the data. The dataset is then split into 3:1 ratio. Individual classifiers are used to train the training dataset and the test dataset is also tested by applying on each classifier and the final output is obtained by majority voting technique bypassing the individual outputs. This is the independent ensemble framework. For this ensembling technique, they used Random Forest, Linear Support Vector Machine and Naive Bayes as the base learners. The accuracy is 99.91% for classification of crops into mainly two seasons i.e. Rabi and Kharif. [7] predicted crop using ensemble technique. Ensembling is a data mining model containing various techniques. This paper discussed the Majority Voting technique. This technique requires that the count of the base learners should not less than 2. The algorithms used with the voting technique are random trees, chaid, K-Nearest Neighbor, Naive Bayes classifiers. [8] used Decision tree, KNN, Random Forest algorithm and Neural Network to predict the crop based on rainfall. The authors implemented map visualization for getting the farmer's location and showing the crop to be yielded in that region. For precision farming, [9] discussed the requirements and planning needed for developing a model. Precision farming is deeply analyzed in this paper. Initially, the basics of precision farming are discussed. The paper developed a model which would work in conjunction with it. Kerala state in India accounts for the lowest average holding land size in the country. This model was designed taking into consideration the state of Kerala since only with minor modifications, this model can be deployed all over India. [10] deals with precision agriculture and the classification algorithms taking into consideration the performance of a particular crop to get insights. The various algorithms, SVM, Neural network, Bagging and Bayes, and Random forest classification are implemented on soya crops. This paper concluded bagging as the classifier for proving the best algorithm for prediction. Table-I shows the summarized results. Each paper concluded the algorithm suitable for their dataset used for a recommendation based on accuracy calculated.

TABLE I.

RESULTS OF CROP RECOMMENDATION IN VARIOUS PAPERS

Paper	*Best Suitable Algorithm*	*Scores*	*Percentage (%)*
[5]	Decision Tree	Accuracy	>75
[6]	Ensembling technique	Accuracy	99.91
[7]	Ensembling technique	Accuracy	88
[8]	Neural Network	Accuracy	91
[10]	Bagging	Relative Absolute Error	9.195

In paper[11] proposed a web scraper system dependent on Dynamic Topic Base and URL filtering. The algorithm also used URLs in the anchor texts to match the dynamic topic used. In this paper, a list of candidate URLs is maintained by a web crawler, which chooses URLs based on priority level and base at a semantic level which in turn estimated the topic relevance of URLs and filtering out the result and updated the list of URLs. [12] proposed an optimized template detection and extraction algorithm for web scraping of dynamic web pages in which the distance measure is used to find out the similarity between DOM trees with respect to the template extracted. For extraction algorithm, for each web page, they created DOM tree and then calculated the feature values and represented them in a matrix format and then they applied the KMeans clustering algorithm to that matrix. [13] proposed a useful application of web-scraping namely a system for Job Search based in which Naive Bayes algorithm is used to find availability of job vacancy with the applied categories so that the user can easily collect job vacancy information from multiple websites. An automated system is designed to search for various websites for collecting the information. The website addresses are taken from the database. After the scraping is done successfully, the result is stored in the database. The result of the system is above 70%. [14] discussed the proper usage of the automated framework based on Selenium and FitNesse. Automated testing is a technology to save time and money and helps the retailers to commit changes faster. Integrating these technologies, the paper concluded reduced testing code lines and development period decreased considerably, lesser error rate, improved coding production as well as the quality of the desired product.

Paper[15] discussed different products for price comparisons such as Yahoo! Shopping and Google Product Search which help the customers in delivering product related data. Here, they provide the quantity of the product along with its cost to find an optimal commodity. [16] discussed collection of product data from different computer shop websites by using web crawling and compared the prices of the products based on the prices sorted in descending order. To get the information from the websites, 'pentaho' software is used and the software requires few stages depending upon the website structure. [17] states, users tend to visit online Ecommerce websites on the advent of ShopBot. Users visit the retailer's website after finding them on ShopBot. The paper concluded, a ShopBot can reduce search time of the user by considering factors namely marginal search costs, price dispersion and quality differentiation among stores, price and quality correlation, and consumers' relative preference for service quality.

The learning's from this survey helped us to formulate a recommendation system by comparing the accuracy scores of different data mining algorithms. These algorithms are applied over a dataset which is generated by merging the parameters from publicly available Indian climatic conditions dataset. The price comparison bots currently present, sort the commodities according to their price. However, a loophole found in these ShopBots is, the price mentioned for a quantity described over a website or multiple websites by vendors is not stated in uniform units (e.g. Rs.100/- for 500 grams cotton seed and

Rs.100/- for 500 cotton seeds). This hinders the comparison, thus decreases the accuracy for finding optimal commodity. This paper proposes an approach to deal with this scenario by converting the price for a quantity described in 'grams' into 'number of seeds' by using 'seeds per gram' ratio. The later section of the paper discusses this system in detail.

III. Proposed Methodology

A. Flowchart

Fig. 1 shows the flowchart of the system. Users can opt for recommending the crop based on current environmental conditions or can provide their query manually. This query is then searched on multiple websites and the data is collected in a datasheet. For web scraping a ShopBot is designed using Selenium framework. Different parameters are stored in the datasheet about the product. This paper focuses on the price and quantity provided by the seller. This data gives us the ratio of price over quantity i.e. price per seed for each item. Ratio with least value is selected as the optimal product and its link is provided to the user.

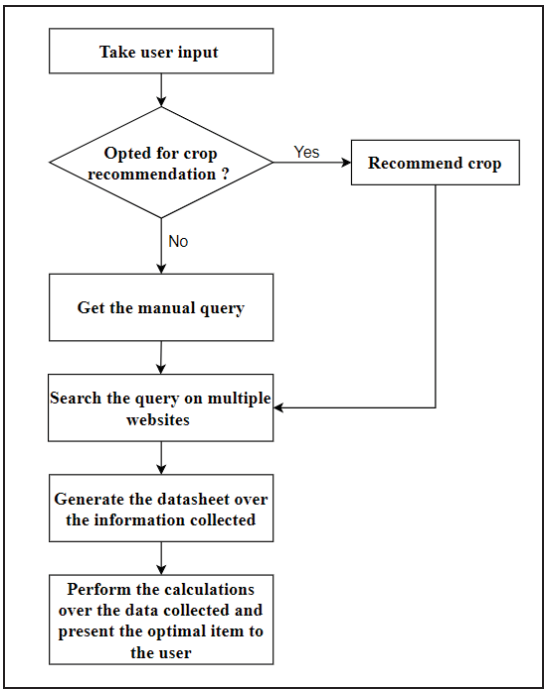

Fig. 1. Proposed Methodology

B. Crop Recommendation

The datasets were taken from data.gov.in for the following parameters Rainfall[18], Temperature[19], Crop cultivated[20] and was merged over a common period of time. The dataset developed includes Crop, Rainfall, Temperature, Season, Year, Production, Area and Location. Efficiency is higher when data-mining algorithms are applied over the data-set to get the desired results.

1) Preprocessing: The data is preprocessed by considering the required features used for the crop recommendation by converting the raw data into a clean data set. Some algorithms which are taken into consideration don't support null values. The data is then normalized and divided in the ratio 7:3 as the train dataset and test dataset. The training set contributes in developing the model for testing purposes. Thus, the performance of the model is calculated for the dataset used.

2) Data Mining Algorithms: The algorithms used in this paper are supervised with multi-class multi-output classification since both the number of properties and the number of classes per property are greater than two. Then the data is trained with classifiers supported by scikit-learn as follows:

a) DecisionTreeClassifier: The robust and well-known tool for classification is the Decision tree. In this classifier according to certain parameters data is continuously splitted. This process is repeated on each subset in a recursive manner called recursive partitioning. The approach which is used in this classifier is Divide and Conquer. This algorithm is extremely fast at classifying unknown records. Unimportant features are excluded by this classifier.

b) ExtraTreeClassifier: It is an extremely randomized version of DecisionTreeClassifier. In this algorithm, samples are selected for each decision tree without replacement. So, all the samples would be unique in nature. The main feature is that the split value selected is random. This accounts for diversified trees and lesser splits for evaluation during the training of data.

c) ExtraTreesClassifier (with ensemble): Completely different Decision tree can be generated if there is a little variation in data. Therefore Decision tree can be unstable. To avoid this problem, ensembling techniques can be used. Different machine learning algorithms are taken together to make a single prediction model. This lowers the variance (bagging), bias (boosting) and improves predictions.

d) KNeighborsClassifier: In KNeighborsClassifier, random value for 'K' is chosen and the distance between a node and remaining nodes in the dataset is calculated. In the case of classification, the output is related to the frequently occurred label or in case of regression, the output is related to the average of the labels.

e) RadiusNeighborsClassifier: The algorithm is similar to KNeighborsClassifier except for two parameters. In RadiusNeighborsClassifier the parameter radius of the fixed area is used to decide whether an observation is a neighbor of the other observations. To find the label of an observation that has no other observations within that radius, the second parameter outlier label is used.

f) RandomForestClassifier: By means of voting it gives the best solution. On data samples, it creates decision trees and then stores all the results of the prediction and then chooses the

solution which has maximum votes. Overfitting is reduced considerably when the ensemble is chosen over a single decision tree as it takes mean of the result.

These algorithms were applied over the dataset and accuracy score was calculated as shown in Fig. 2 in Section-IV.

C. Web Scraping

Web scrapers are a subset of web crawlers that search out for specific information on a website. The ShopBot developed in this paper is a web-scraper. Data from web pages could be accessed using Text - grepping and regular expressions. This is a UNIX command; it matches text with its occurrences in the data. Most of the web pages are based on 'grep' command since it is a powerful method and simple technique to extract information. Regular expression matching methods based on different programming languages for example Python, Perl, are also used for data extraction. A DOM parser can be used as well. It parses the web pages and creates a DOM-object or a parse tree which has nodes and then the data is accessed from these dedicated nodes. Once the data is accessed, it needs to be analyzed.

1) Comparison of Web Scraping Frameworks

Comparison of different web-scraper frameworks primarily Selenium, Beautiful Soup and Scrapy is as follows:

a) Selenium: It is a versatile web crawler because of its ability to do automated testing and web scraping at the same time. It is good when working with Javascript (JS). It is used for scraping E-commerce websites since they use JS to dynamically load pages.

b) Beautiful soup: It is easy to learn however inefficient as web scraping is a slow process. It is used for HTML and XML parsing.

c) Scrapy: It is asynchronous and can send multiple requests at a time. It is faster since it does not wait for a response. However, the setup is large.

The most suitable as well as an accurate framework for our system is Selenium as our principal task is to scrape multiple E-commerce websites.

2) Selelenium Framework: The tasks of form submissions or clicking over various links is automated using a python script. Navigation over URL is performed by driver.get function. WebDriver on the load of the web-page, returns to the script. Ecommerce websites require AJAX for loading of data, hence Selenium provides flexibility to return to the script only after a complete load of web-page. Alternately, implicitly time.sleep() can be used to wait. Information on a web-page can be identified using the find element by_ * methods. The XPath expression provided for a web-page is converted into a class-based structure by a parser to construct syntax-tree. It uses Depth First Search or Breadth First Search or both to parse information present on the nodes of the syntax tree. Query operations can be applied over these nodes as per our requirements.

D. Price Comparison (ShopBot)

Price comparison is performed using price comparison websites conventionally called ShopBot. ShopBot is a vertical search engine that is used to filter out commodities for comparison over price, review and other features. The data related to a commodity on the website is collected using web scrapers. Over various websites, the parameters used for defining quantity would be in grams, however, to determine the optimal solution, the ratio 'price per seed' is considered. Hence, the data collected in grams would be converted into 'seeds per gram' for further calculations.

e.g.

Price of 50 grams Watermelon seeds is Rs.850/−
6 Watermelon seeds approximately weigh 1gram

$\therefore$ 50 grams Watermelon would account for $50 * 6 = 300$ seeds

$\therefore$ 'price per seed' ratio = 850/300 = 2.82

The 'price per seed' ratio is considered for price comparison. The quantity of crop seeds present on multiple websites is in the form 'price per gram'. In this scenario, the table on [21] is referred. This table provides the relation between 'seeds per gram'. This in-turn gives 'price per seed' and results in data adequacy for price comparison. Thus, a spreadsheet is generated where the commodity details along with their website links would be stored and the optimal 'price per seed' ratio will be displayed to the user.

IV. RESULTS

Fig. 2 shows the visualization over the accuracy score calculated on the data mining algorithms discussed in Subsection III-B. DecisionTreeClassifier gave the highest accuracy of 87% followed by the RandomForestClassifier which gave an accuracy of 86%.

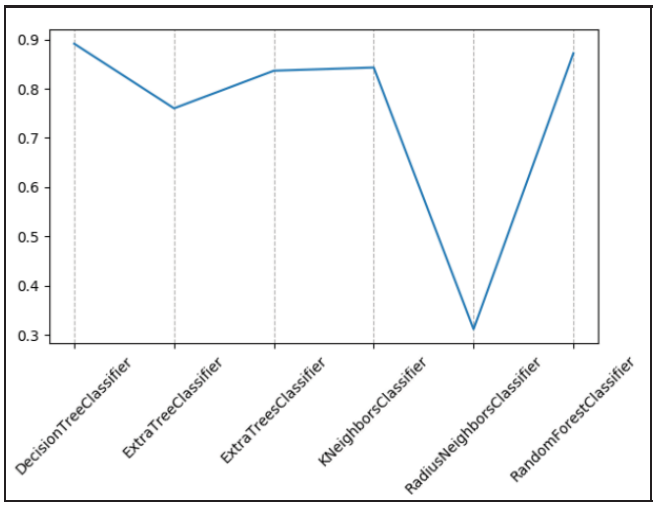

Fig. 2. Accuracy of Different Classifiers

Fig. 3 shows the initial web-page loaded by the system. There are two input options available, either recommending the crop or manual query for purchasing crop seeds.

Fig. 4 shows the recommended crop using the classification algorithm that gave maximum accuracy, here it is DecisionTreeClassifier. The recommended crop is apple. It is then used as a parameter to the ShopBot.

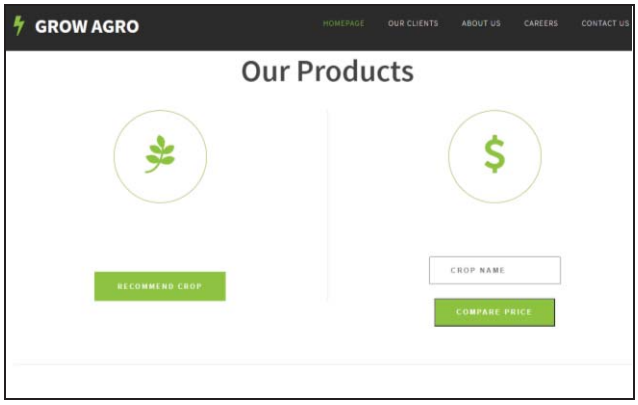

Fig. 3. Single Platform Webpage

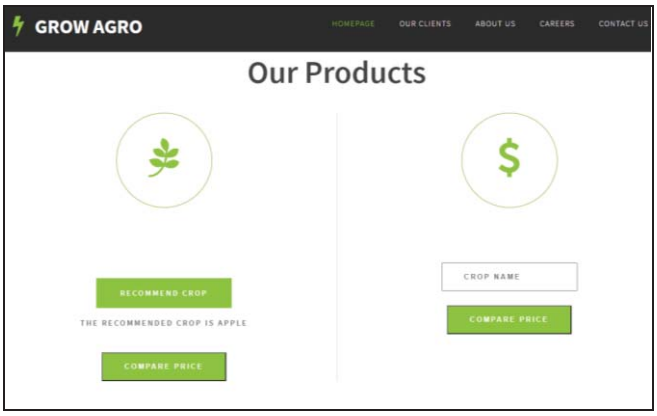

Fig. 4. Output after Recommendation

Alternately, Fig. 5 shows that the user can insert the crop name manually as per the requirement (e.g. 'watermelon' is inserted as the query). The websites scraped are namely [22], [23], [24]. Fig. 6 shows data collected from these websites for watermelon seeds. Referring to this data, an optimally priced commodity can be selected for purchasing.

As it can be noticed that there are various items for the same product on a single website, the ShopBot scrapes all these items from all of the websites. Thus, the chances of any commodity getting overlooked are reduced.

From the spreadsheet in Fig.6, the column 'Quantity' is presented in the way it has been described on the respective website. However, calculations are performed over the quantity present in grams for calculating the 'price per seed' ratio.

The row which contains the minimum 'price per seed' ratio is the optimal product. Its corresponding link will be delivered on the platform for the consumers to buy the commodity from.

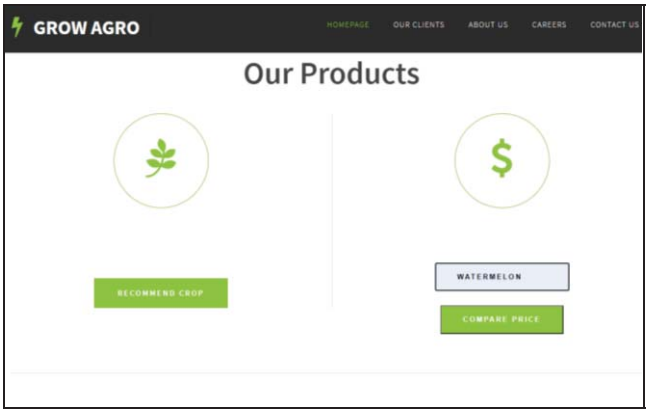

Fig. 5. Manual User Query

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	A	B	C	D	E	F
		Name	Quantity	Price	Ratio	Link
0		MaxX WATERMELON	1000 seeds	1,925	1.925	https://www.bighaat.com/products/maxx-watermelc
1		MAHIMA WATERMELON	1000 seeds	1,210	1.21	https://www.bighaat.com/products/mahima-water-n
2		GULFAM WATERMELON	500 seeds	380	0.76	https://www.bighaat.com/products/gulfam-waterme
3		PAKEEZA WATERMELON	1000 seeds	680	0.68	https://www.bighaat.com/products/pakeeza-waterm
4		595 WATERMELON	300.0 seeds	195	0.65	https://www.bighaat.com/products/595-watermelon
5		RAMYA WATERMELON	300.0 seeds	270	0.9	https://www.bighaat.com/products/ramya-watermel
6		SULTAN WATERMELON	300.0 seeds	785	2.616666667	https://www.bighaat.com/products/sultan-watermel
7		NS 750 WATERMELON	300.0 seeds	320	1.066666667	https://www.bighaat.com/products/ns-750?_pos=11
8		NS 777 WATERMELON	300.0 seeds	400	1.333333333	https://www.bighaat.com/products/ns-777?_pos=12
9		NS 295 WATERMELON	300.0 seeds	310	1.033333333	https://www.bighaat.com/products/ns-295?_pos=13
10		KIRAN-2 WATERMELON	300.0 seeds	1,625	5.416666667	https://www.bighaat.com/products/water-melon-kn
11		ARUN WATERMELON (ar	150.0 seeds	700	4.666666667	https://www.bighaat.com/products/arun-watermelo
12		APOORVA WATERMELON	300.0 seeds	295	0.983333333	https://www.bighaat.com/products/watermelon-ser
13		MAHY MHW-6 (Watermel	300.0 seeds	310	1.033333333	https://www.bighaat.com/products/mahy-6-mhw-6?
14		AISHWARYA WATERMELC	300.0 seeds	200	0.666666667	https://www.bighaat.com/products/aishwarya-water
15		ANMOL YELLOW WATERM	60.0 seeds	600	10	https://www.bighaat.com/products/anmol-yellow-wa
16		Urja Watermelon F-1 Hyb	250 Gm	697	0.464666667	https://agribegri.com/products/urja-watermelon-f-1-
17		Urja Watermelon F-1 Hyb	100 Gm	270	0.45	https://agribegri.com/products/urja-watermelon-f-1-
18		Urja Watermelon F-1 Hyb	50 Gm	300	1	https://agribegri.com/products/urja-watermelon-f1-h
19		Sugar Baby Hybrid Water	50 Gm	950	3.166666667	https://agribegri.com/products/hybrid-water-melon-s
20		Cool Queen Hybrid Water	50 Gm	200	0.666666667	https://agribegri.com/products/cool-queen-hybrid-wa
21		Urban Organic Watermelc	900 seeds	549	0.61	https://www.flipkart.com/urban-organic-watermelon
22		Paudha WATERMELON Se	10 seeds	96	9.6	https://www.flipkart.com/paudha-watermelon-seed/
23		Paudha WATERMELON Se	50 seeds	210	4.2	https://www.flipkart.com/paudha-watermelon-seed/
24		Urban Organic Watermelc	400 seeds	325	0.8125	https://www.flipkart.com/urban-organic-watermelon

Fig. 6. CSV File of Extracted Information

V. Conclusion And Future Work

This paper has proposed a single platform for crop recommendation and its optimal pricing. The crop is recommended using data mining techniques focusing on the essential parameters that affect the crop's cultivation. Dedicated web-scrapers are developed for finding an optimal website for the crop seeds to be purchased. This system would prove beneficial for farmers to purchase products for their farm.

In future, the system can be implemented for fertilizer and other agricultural equipment recommendations and dedicated web scrapers can be developed for it. The system can be further inculcated with additional farming activities to ease out the technical section from the farmer's curriculum.

References

[1] Sherali Zeadally, Farhan Siddiqui, Zubair Baig, Ahmed Ibrahim (2019), "Smart healthcare: Challenges and potential solutions using internet of things (IoT) and big data analytics" PSU – A Review Journal, pp. 1-17.

[2] Bhaskar Chakravorti, "A game plan for technology companies to actually help save the world," The Conversation: In-depth analysis, research, news and ideas from leading academics and researchers., 06-Nov-2018.

[3] Ozcelik, Yasin, "Electronic Loyalty Programs Comparative Survey," in Encyclopedia of Information Communication Technology, edited by Antonio Cartelli and Marco Palma, IGI Global, 2009, ch. 38, pp. 286-290.

[4] Palanisamy, R., Verville, J. and Taskin, N. (2015), "The Critical Success Factors (CSFs) for Enterprise Software Contract Negotiations: An Empirical Analysis", Journal of Enterprise Information Management (JEIM)., 28(1), 34-59.

[5] S. Veenadhari, B. Misra, and C. Singh, "Machine learning approach for forecasting crop yield based on climatic parameters," in *2014 International Conference on Computer Communication and nformatics*. IEEE, 2014, pp. 1–5.

[6] N. H. Kulkarni, G. N. Srinivasan, B. M. Sagar and N. K. Cauvery, "Improving Crop Productivity Through A Crop Recommendation System Using Ensembling Technique," *2018 3rd International Conference on Computational Systems and Information Technology for Sustainable Solutions (CSITSS)*, Bengaluru, India, 2018, pp. 114-119, doi: 10.1109/CSITSS.2018.8768790.

[7] S. Pudumalar, E. Ramanujam, R. H. Rajashree, C. Kavya, T. Kiruthika, and J. Nisha, "Crop recommendation system for precision agriculture," *2016 Eighth International Conference on Advanced Computing (ICoAC)*. IEEE, 2017, pp. 32–36.

[8] Z. Doshi, S. Nadkarni, R. Agrawal, and N. Shah, "Agroconsultant: Intelligent crop recommendation system using machine learning algorithms," in *2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA)*. IEEE, 2018, pp. 1–6.

[9] S. Babu, "A software model for precision agriculture for small and marginal farmers," in *2013 IEEE Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS)*. IEEE, 2013, pp. 352–355.

[10] Savla, N. Israni, P. Dhawan, A. Mandholia, H. Bhadada, andS. Bhardwaj, "Survey of classification algorithms for formulating yieldprediction accuracy in precision agriculture," in2015 International Con-ference on Innovations in Information, Embedded and CommunicationSystems (ICIIECS). IEEE, 2015, pp. 1–7.

[11] M.-s. Zhao, P. Zhu, and T.-c. He, "An intelligent topic web crawler based on dtb," in *2010 International Conference on Web Information Systems and Mining*, vol. 1. IEEE, 2010, pp. 84–86.

[12] G. Gupta and I. Chhabra, "Optimized template detection and extraction algorithm for web scraping of dynamic web pages," *Global J. Pure Appl. Math*, vol. 13, no. 2, pp. 719–732, 2017.

[13] C. Slamet, R. Andrian, D. S. Maylawati, W. Darmalaksana, M. Ramdhani *et al.*, "Web scraping and naïve bayes classification for job search engine," in *IOP Conference Series: Materials Science and Engineering*, vol. 288, no. 1. IOP Publishing, 2018, p. 012038.

[14] X. Wang and P. Xu, "Build an auto testing framework based on selenium and fitnesse," in *2009 International Conference on Information Technology and Computer Science*, vol. 2. IEEE, 2009, pp. 436–439.

[15] K. A. Passyn, M. Diriker, and R. B. Settle, "Price comparison, price competition, and the effects of shopbots," *Journal of Business & Economics Research (JBER)*, vol. 11, no. 9, pp. 401–416, 2013.

[16] L. R. Julian and F. Natalia, "The use of web scraping in computer parts and assembly price comparison," in *2015 3rd International Conference on New Media (CONMEDIA)*. IEEE, 2015, pp. 1–6.

[17] J. Zhang and B. Jing, "The impacts of shopbots on online consumer search," in *2011 44th Hawaii International Conference on System Sciences*. IEEE, 2011, pp. 1–10.

[18] "Rainfall india dataset," data.gov.in. [Online]. Available: https://data.gov.in/catalog/rainfall-india.

[19] "Temperature india dataset," data.gov.in. [Online]. Available: https://data.gov.in/catalog/annual-and-seasonal-mean-temperature-india.

[20] "Crop prediction india dataset," data.gov.in. [Online]. Available: https://data.gov.in/catalog/district-wise-season-wise-crop-production-statistics.

[21] "Seeds per gram," Green Harvest. [Online]. Available: https://greenharvest.com.au/SeedOrganic/SeedsPerGram.html.

[22] Bighaat, "Agriculture Products Online: Buy Agricultural Products Online," BigHaat.com. [Online]. Available: https://www.bighaat.com/.

[23] "Cheap Online Shop for Fertilizers, Insecticides, Seeds and Agricultural Products," AgriBegri. [Online]. Available: https://www.agribegri.com/.

[24] "Online Shopping Site for Mobiles, Electronics, Furniture, Grocery, Lifestyle, Books & More. Best Offers!," Flipkart.com. [Online]. Available:https://www.flipkart.com/.