SAVITRIBAI PHULE PUNE UNIVERSITY A Project Report on Machine Learning Techniques For Crop Yield Prediction SUBMITTED TOWARDS THE PARTIAL FULFILLMENT OF THE REQUIREMENTS OF BACHELOR OF ENGINEERING (Computer Engineering) By Prajwal Sable Exam No:COMPBEA1102 Ashish Dongare Exam No:COMPBEA1103 Atharva Mohite Exam No:COMPBEA1104 Mandar Kulkarni Exam No:COMPBEA1109 Under The Guidance of Mrs.Vaishali Kolhe Department of Computer Engineering D. Y. Patil College of Engineering, Akurdi. D. Y. Patil College of Engineering, Akurdi. Department of Computer Engineering CERTIFICATE This is to certify that the Project Entitled Machine Learning Techniques For Crop Yield Prediction Submitted by Prajwal Sable Exam No:COMPBEA1102 Ashish Dongare Exam No:COMPBEA1103 Atharva Mohite Exam No:COMPBEA1104 Mandar Kulkarni Exam No:COMPBEA1109 is a bonafide work carried out by Students under the supervision of Mrs.Vaishali Kolhe and it is submitted towards the partial fulfillment of the requirement of Bachelor of Engineering (Computer Engineering). Mrs.Vaishali Kolhe Dr.M.A.Potey Internal Guide H.O.D Dept. of Computer Engg. Dept. of Computer Engg. Principal D. Y. Patil College of Engineering, Akurdi Pune 44 Signature of Internal Examiner Signature of External Examiner PROJECT APPROVAL SHEET A Project Title Machine Learning Techniques For Crop Yield Prediction is successfully cpmpleted by Prajwal Sable Exam No:COMPBEA1102 Ashish Dongare Exam No:COMPBEA1103 Atharva Mohite Exam No:COMPBEA1104 Mandar Kulkarni Exam No:COMPBEA1109 at DEPARTMENT OF COMPUTER ENGINEERING (D. Y. Patil College of Engineering, Akurdi.) SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE ACADEMIC YEAR 2022-2023 Mrs.Vaishali Kolhe Dr.M.A.Potey Internal Guide H.O.D Dept. of Computer Engg. Dept. of Computer Engg. ABSTRACT As agriculture being the primary occupation of India, large part of population invests in agriculture activities. But the figures show that despite being into agriculture activities all these years, there is not satisfactory growth in agriculture sector. The major reason behind this is poor productivity due to lesser yield of crops. The lack of knowledge, resources and poor policies deplete the crop yields, subsequently leading farmers to take harsh decisions. There has been research on crop patterns, soils, and climatic conditions to boost yield of crops, but still results are not up to mark. The reason for this is less research or faults in it, but the research work is not being utilized by farmer as there is not platform or medium through which farmers can use this knowledge. So the project aims to develop platform which will be providing interface where an farmer as well market persons can get descriptive as well as predictive analysis regarding crop patterns, that will help to increase crop yield as well farmer can get better idea regarding cop patterns and recent market requirements ACKNOWLEDGEMENT It gives us great pleasure in presenting the preliminary project report on ‘Machine Learning Techniques For Crop Yield Prediction’. I express sincere and profound thanks to Mrs.Vaishali Kolhe, seminar Guide, and HOD Prof. Dr.M.A.Potey, who was ready to help with the most diverse problems that I have encountered along the way.We express sincere thanks to all staff and colleagues who have helped directly or indirectly in completing this project successfully. Prajwal Sable Ashish Dongare Atharva Mohite Mandar Kulkarni (B.E. Computer Engg.) 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ML : Machine Learning 2. SVM : Support Vector Machine B.E. Project Machine Learning Techniques For Crop Yield Prediction 1 Synopsis 1.1 Project Title Machine Learning Techniques For Crop Yield Prediction 1.2 Project Option Internal Project 1.3 Internal Guide Mrs. Vaishali Kolhe 1.4 Sponsorship and External Guide 1.5 Technical Keywords Machine Learning Support Vector Machine Feature extraction Random Forest Algorithm D.Y.P.C.O.E., Akurdi, Pune 1 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 1.6 Problem Statement To predict the crop that will give better yield in field based on features like location,climate and physiography using Machine Learning. 1.7 Abstract As agriculture being the primary occupation of India, large part of population invests in agriculture activities. But the figures show that despite being into agriculture activities all these years, there is not satisfactory growth in agriculture sector. The lack of knowledge, resources and poor policies deplete the crop yields, subsequently leading farmers to take harsh decisions. There has been research on crop patterns, soils, and climatic conditions to boost yield of crops, but still results are not up to mark. So the project aims to develop platform which will be providing interface where an farmer as well market persons can get descriptive as well as predictive analysis regarding crop patterns, that will help to increase crop yield as well farmer can get better idea regarding cop patterns and recent market requirements 1.8 Goals and Objectives • By considering various factors such as soil conditions, rainfall, temperature, yield and other entities the system builds a predicting a model using machine learning techniques. • The main Aim of crop yeild prediction is to help farmers for plantation to maximize their earning. • Another goal of crop yield prediction is to play an important role in decision making at global, regional and field levels. D.Y.P.C.O.E., Akurdi, Pune 2 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 1.9 Relevant mathematics associated with the Project System Description: • Input : User input (location,soil type ,climate) • Output : Prediction of crop that will give best yield /profit. 1.10 Conferences/Journals where papers can be published • IEEE/ACM - International Conference on Machine Learning and Applications • Conferences/Workshops in IITs • Central Universities or SPPU • Springer/ACM Conference/IEEE International Conference on AI for Good D.Y.P.C.O.E., Akurdi, Pune 3 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 1.11 Review of Conference/Journal Supporting Project Idea Sr. No. Title and Authors Conference / Journal Name and Publication Year Topic Reviewed/ Algorithms or methodology used Advantages and disadvantages 1 Crop yield prediction using machine learning: A systematic literature review Authors: Thomasvan Klompenburg , AyalewKassahun, Cagatay Catal Elsevier,” Computers and Electronics in Agriculture 177 (2020) 105709 ”,August 2020 Detailed presentation of machine learning and deep learning techniques with results , which suggest crop based on input parameters like soil, temperature, etc. Advantage: The proper writing, elaboration and applications of concepts along with results. 2 Prediction of Crop Yield using Regression Analysis Authors: Renuka, Sujata Terdal Indian Journal of Science and Technology, Vol 9(38), October 2016 deeply elaborated and explained the approach of Regression clearer picture of regression algorithm for classification. D.Y.P.C.O.E., Akurdi, Pune 4 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Sr. No. Title and Authors Conference / Journal Name and Publication Year Topic Reviewed/ Algorithms or methodology used Advantages and disadvantages 3 Evaluation of Machine Learning Algorithms for Crop Authors: Kshira Sagar Sahoo, Bata Krishna Tripathy, Bata Krishna Tripathy, Somula Ramasubbareddy IJEAT, Volume8 Issue-6, August, 2019 Authors have proposed support vector machine, decision tree and KNN methodology Advantage: Simple and clear explanation 4 Impact of Machine Learning Techniques in Precision Agriculture Authors: Rahul Katarya, Ashutosh Raturi, Abhinav Mehndiratta, Abhinav Thapper 3rd International Conference on Emerging Technologies in Computer Engineering IEEE Xplore ,14 may 2020 Explained different applications of machine learning for agriculture. Advantage: Provides brief description about ml techniques that can help in agriculture sector. D.Y.P.C.O.E., Akurdi, Pune 5 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Sr. No. Title and Authors Conference / Journal Name and Publication Year Topic Reviewed/ Algorithms or methodology used Advantages and disadvantages 5 Machine Learning in Agriculture: A Comprehensive Updated Review Sensors 2021, Published: 28 May 2021 presents a role of machine learning in agriculture optimization. Advantages: Different approaches explained 6 A Study on Crop Yield Forecasting Using Classification Techniques Authors: P. Isakki, R. Sujatha 2016 International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE’16) In this paper, we have demonstrated to estimate the crop yield, choose the most excellent crop, thereby improves the value and gain of the farming area using data mining techniques Advantage: Provides brief description about ml techniques D.Y.P.C.O.E., Akurdi, Pune 6 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Sr. No. Title and Authors Conference / Journal Name and Publication Year Topic Reviewed/ Algorithms or methodology used Advantages and disadvantages 7 Agriculture Decision Support System using Data Mining Authors: Rakesh Shirsath, Neha Khadke, Divya More, Pooja Patil; Harshali Patil 2017 International Conference on Intelligent Computing and Control (I2C2) IEEE Xplore: 22 March 2018 Paper presents the Process of building prediction model for crop yield briefly. Advantage: Simple and clear explanation 8 Applications of Machine Learning Techniques in Agricultural Crop Production: A Review Paper Authors: Subhadra Mishra, Debahuti Mishra1 and Gour Hari Santra Indian Journal of Science and Technology, Vol 9(38), Oct 2016 IEEE Xplore ,14 may 2020 : research studies on the relevance of machine learning techniques in the domain of agricultural crop production. This paper describes how improving agriculture yields by previous agriculture information D.Y.P.C.O.E., Akurdi, Pune 7 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Sr. No. Title and Authors Conference / Journal Name and Publication Year Topic Reviewed/ Algorithms or methodology used Advantages and disadvantages 9 Performance Analysis of Supervised Learning Algorithms based on Classification Approach Authors: Fazeel Ahmed Khan, Adamu Abubakar Ibrahim 2019 6th IEEE ICETAS Explained different ML algorithms, methodology and different performance evaluation techniques. Advantage: Evaluation techniques can be utilized to apply the given algorithm in different required use-cases 10 Performance Evaluation of Best Feature Subsets for Crop Yield Prediction Using Machine Learning Algorithms Authors: Bhargavi R, Maya Gopal P. S. Publishes online: 05 Apr 2019 T evaluates the most needed features for accurate crop yield production. Advantage: brief description Table 1.1: Review of Conference/Journal Supporting Project Idea D.Y.P.C.O.E., Akurdi, Pune 8 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 1.12 Plan of Project Execution Topic Module Head current status plan of completion Requirement Analysis Ashish Done October Data Collection/Analysis Ashish , Mandar Started November Model Generation Atharva Started December Testing Prajwal,Ashish January UI Design Prajwal,Mandar In operation February Documentation Prajwal In operation March Table 1.2: Plan of Project Execution D.Y.P.C.O.E., Akurdi, Pune 9 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 2 Technical Keywords 2.1 Area of Project Data Analysis, Crop Study, Machine Learning 2.2 Technical Keywords • Machine Learning • Support Vector Machine • Feature extraction • Random Forest Algorithm D.Y.P.C.O.E., Akurdi, Pune 10 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 3 Introduction 3.1 Project Idea The farmer face the issue of lesser crop yield, due to improper crop pattern, less resources and many of such factors. The goal here is to solve this problem, by creating platform where user (in this case farmer) can sign in ,get prediction of crop that will give better production outcome. department. 3.2 Motivation of the Project As in India, farming is one of the primary occupation of most of population still we lack in the profits/economy when it comes to farming. The lack of knowledge, resources and poor policies deplete the crop yields ,subsequently leading farmers to take harsh decisions. Also, almost everyone from team comes from farmers background and have faced/seen similar issues. Hence, it seemed the perfect opportunity as software engineers to deliver a product which can help farmers to boost their crop yield ,providing them right market, acquainting with better policies /schemes thereby help them doing agriculture is more resourceful way. D.Y.P.C.O.E., Akurdi, Pune 11 Department of Computer Engineering B.E. 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Project Machine Learning Techniques For Crop Yield Prediction 4 Problem Definition and Scope 4.1 Problem Statement To predict the crop that will give better yield in field based on features like location,climate and physiography using Machine Learning. 4.1.1 Goals and Objectives • By considering various factors such as soil conditions, rainfall, temperature, yield and other entities the system builds a predicting a model using machine learning techniques. • To implement ML algorithms 4.1.2 Statement of Scope Our project aims to predict the crop that will give better yield results to farmers by means of 1.Data Analysis of inputs like soil,climate and location dataset. 2. Machine learning classifcation methods The user’s input will include parameters like location,soil,etc and output would be in form of number of crop/crops that will give better production. 4.2 Major Constraints Real time data of crop production and climatic conditions D.Y.P.C.O.E., Akurdi, Pune 17 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 4.3 Methodologies of Problem Solving and Efficiency Issues 4.3.1 Classification techniques 1. Support Vector Machine Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine. Hyperplane: There can be multiple lines/decision boundaries to segregate the classes in n-dimensional space, but we need to find out the best decision boundary that helps to classify the data points. This best boundary is known as the hyperplane of SVM. The dimensions of the hyperplane depend on the features present in the dataset, which means if there are 2 features (as shown in image), then hyperplane will be a straight line. And if there are 3 features, then hyperplane will be a 2-dimension plane. We always create a hyperplane that has a maximum margin, which means the maximum distance between the data points. Support Vectors:The data points or vectors that are the closest to the hyperplane and which affect the position of the hyperplane are termed as Support Vector. Since these vectors support the hyperplane, hence called a Support vector. 2. Random Forest ALgorithm Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in Machine learning. D.Y.P.C.O.E., Akurdi, Pune 18 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model. As the name suggests, ”Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset.” Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.The greater number of trees in the forest leads to higher accuracy and prevents the problem of overfitting.Since the random forest combines multiple trees to predict the class of the dataset, it is possible that some decision trees may predict the correct output, while others may not. But together, all the trees predict the correct output. D.Y.P.C.O.E., Akurdi, Pune 19 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 4.4 Outcome A User (Farmer) can get prediction or recommendation for crops to be cultivated based upon his input parameters . 4.5 Applications 1.Famer can get pre-idea of crop pattern which will help to increase the production. 2. To create a centralized platform /communication medium for farmer where results study can be shared . 3.Motivate Further studies and improvement in filed of ML with agriculture. 4.6 Hardware Resources Required Sr .No Parameter Minimum Requirement Justification 1 CPU speed 2 GHz Multi Threading 2 RAM 2 GB High Processing Speed Table 4.1: Hardware Requirements 4.7 Software Resources Required 1. Operating System: Windows 10 2. IDE: Visual Studio Code, Jupyter Notebook, Notepad++ 3. Programming Language: Python,Javascript D.Y.P.C.O.E., Akurdi, Pune 20 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 5 Project Plan 5.1 Project Estimates 5.1.1 Reconciled Estimates Cost Estimate: Nil Time Estimates: By March 2023, the GUI will be ready to use 5.1.2 Project Resources People 1. Software Developer (Python) 2. Operating Systems Engineer 3. User Interface (UI/UX) Engineer Minimum Hardware Requirements 1. RAM 4 GB 2. Storage 20 GB Software Requirements 1. Visual Studio Code 5.2 Risk Management w.r.t. NP-Hard Analysis Project Risk Analysis and Management is a process that enables the analysis and management of the risks associated with a project. Properly undertaken it will increase the likelihood of successful completion of a project to cost, time, and performance objectives. Project Risk Analysis and Management is a process designed to remove or reduce the risks which threaten the achievement of project objectives. The next section of this D.Y.P.C.O.E., Akurdi, Pune 21 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Guide describes the benefits which Project Risk Analysis and Management can bring to a project and also the wider benefits to the organization and its customers. 5.2.1 Risk Identification For risks identification, a review of the scope document, requirements specifications, and schedule is done as follows: Sr. No. Questions Answers 1 Are end-users enthusiastically committed to the project and the system/product to be built Yes 2 Are requirements fully understood by the software engineering team and its customers Yes 3 Do end-users have realistic expectations Yes 4 Does the software engineering team have the right mix of skills Yes 5 Are project requirements stable Yes 6 Is the number of people on the project team adequate to do the job Yes 7 Do all customer/user constituencies agree on the importance of the project and on the requirements for the system/product to be built Yes Table 5.1: Risk Identification 5.3 Project Schedule 5.3.1 Project Task Set Major Tasks in the Project stages are: 1. Crop Data Collection 2. Crop Data Analysis 3. Model Development 4. Testing 5. User Interface Design D.Y.P.C.O.E., Akurdi, Pune 22 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 5.3.2 Task Network Figure 5.1: Task Network 5.3.3 Timeline Chart Topic current status plan of completion Requirement Analysis Done October Data Collection/Analysis Started November Model Generation Started December Testing January UI Design In operation February Documentation In operation March Table 5.2: Timeline Chart 5.4 Team Organization Project Guide: Mrs. Vaishali Kolhe Project Lead: Prajwal Sable UI Developer: Mandar Kulkarni Crop Analysis Module Head: Atharva Mohite Documentation and Maintenance Head:Ashish Dongare Github.com is used for reporting and keeping all work in sync with all members of the group D.Y.P.C.O.E., Akurdi, Pune 23 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 5.4.1 Team Structure Prajwal Sable : Responsible for Crop dataset Analysis and Feature study Mandar Kulkarni:Responsible for developing the User Interface Atharva Mohite:Responsible for Crop Prediction Module Ashish Dongare: Responsible for Code Maintenance, Documentation and Resource Management 5.4.2 Management Reporting and Communication Github is used for reporting and keeping all work in sync with all members of the group D.Y.P.C.O.E., Akurdi, Pune 24 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6 Software Requirement Specification 6.1 Introduction 6.1.1 Purpose and Scope of Document This document has been created to give a brief overview of the project “Machine Learning Techniques For Crop Yield Prediction”. It covers all the applicationrelated information including specification, purpose, uses, etc. This project is made to help farmers to decide the crop to be cultivated in the farm that will give better yield production 6.1.2 Overview of Responsibilities of Developer The developers have extensively worked on Crop data Analysis followed by Crop Yield Prediction . These two modules are then merged and bound together with the help of a user-friendly interface. 6.2 Usage Scenario 6.2.1 User Profiles The profiles of all user categories are described here. User: The user can use this software to get crop recommendation having better yield results Developer: The developer can add and modify functionalities based on user feedback from time to time to make the software more precise, accurate, and helpful to users. D.Y.P.C.O.E., Akurdi, Pune 25 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6.2.2 Use Cases Sr. No. Use case Description Actor Assumptions 1 Enter data input the required parameters of crops User Nil 2 Get Results hit results tab to get crop predictions User Nil Table 6.1: Use Cases 6.2.3 Use Case View Figure 6.1: Use Case Diagram D.Y.P.C.O.E., Akurdi, Pune 26 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6.3 Data Model and Description 6.3.1 Data Description Text Data: The data wil be textual in form of parameters like soil type,location and climate. 6.3.2 Data Objects and Relationships Figure 6.2: Data Object and Relationship Diagram The above diagram shows the relation between the data objects i.e. how input is given and how results are obtained D.Y.P.C.O.E., Akurdi, Pune 27 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6.4 Functional Model and Description The class diagram shows the relation between all the functions, modules, data structures and shows the links i.e. extends and aggregation Figure 6.3: Class Diagram D.Y.P.C.O.E., Akurdi, Pune 28 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6.4.1 Data Flow Diagram A. Level 0 data flow diagram Figure 6.4: Level 0 Data Flow Diagram B. Level 1 data flow diagram Figure 6.5: Level 1 Data Flow Diagram D.Y.P.C.O.E., Akurdi, Pune 29 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 6.4.2 Activity Diagram Figure 6.6: Activity Diagram 6.4.3 Non Functional Requirements: Performance Requirements The accuracy of the proposed system is better than the previous data programming paradigms such as SVM Model. The end-user has to just feed the data once the system and the entire further process are automated. No manual intervention after training the data is demanded Software Quality Attributes : 1. Correctness: The correctness of the system depends on the accuracy of the model. If the dataset is accurate according to the personality dataset then the system has achieved its correctness to the maximum level. 2. Reliability: The system is reliable because every module has its reconstruction and recording possible multiple times. 3. Robustness: The system is robust enough to perform preprocessing and manipulations over large datasets. Compatible with different operating systems. 4.Efficiency: Higher the GPU, CPU, and RAM processing higher is the efficiency. The efficiency also depends on the quality of the input data. D.Y.P.C.O.E., Akurdi, Pune 30 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 5. Maintainability: It depends on the following factors: a) Readability: The dataset is readable and preprocessing is being done to reduce the noise in the system. b) Extensibility: The dataset can be of variable size from Kilobytes to Megabytes. The system is capable of performing computations on small, medium, and large datasets. c) Testability: Generation of the correct labels leads to the development of the correct test cases and test plans for future testing 6. Availability: The input dataset must be available in a segregated manner so that it is easy to manipulate. 7. Usability: The system is easy to handle, it also navigates expectedly with minimum delays. In such a case, the system reacts accordingly and transverses quickly between its states 6.4.4 State Diagram A state diagram is the graphical representation of a state machine and one of the 14 UML diagram types for software and systems. State diagrams show a behavioral model consisting of states, state transitions, and actions. State diagrams depict the permitted states and transitions as well as the events that affect these transitions. D.Y.P.C.O.E., Akurdi, Pune 31 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Figure 6.7: State Transition Diagram 6.4.5 Design Constraints 1. Language: Python 2. Technologies: Machine Learning 3. Database: CSV and Hard Disk Drive 4. Estimated Time of Completion: March 2023 5. Testing: Manual 6.4.6 Software Interface Description The user will be required to open the application and enter the required crop data of him/her. Then data can be analyzed using various machine learning techniques. The result of the analysis will be shown to the user in both textual and graphical form,i.e. the crops will give better yield production. D.Y.P.C.O.E., Akurdi, Pune 32 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 7 Detailed Design Document Using Appendix 7.1 Introduction Crop yield Prediction : The Project Aims to help farmers by predicting the crop that will give better yield in farm. The idea here is to take input from farmers like soil,location,irrigation facility,climate etc and based upon that create a a machine learning classfier using previous year dataset ,thus predicting results. 7.2 Architectural Design Figure 7.1: System Architecture Diagram D.Y.P.C.O.E., Akurdi, Pune 33 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 7.3 Data Design (Using Appendices A and B) 7.3.1 Internal Software Data Structures Crop data: input parameters 7.3.2 Global Data Structure Dataset : source 7.3.3 Database Description Crop prediction Model File- For storing structured data and relations Train and Test Dataset File- For Model Generation UI/UX File- Using HTML ,CSS,Javascript,Flask D.Y.P.C.O.E., Akurdi, Pune 34 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 7.4 Component Design 7.4.1 Class Diagram Class diagram is a type of static structure diagram that describes the structure of a system by showing the system’s classes, their attributes, operations, and the relationships among objects Figure 7.2: Class Diagram The above diagram shows the relation between all the functions, modules, data structures, their attributes and operations of our project. It also shows “extends” and “aggregation” features. The video and audio modules are in aggregation with the user class. Emotion analysis, voice confidence analysis, and speech analysis extend the required modules and classes for predicting the personality of the user. 7.4.2 Interaction Diagram An interaction Diagram is used to picture a control flow with nodes that can contain various functionalities. It shows the sequence in which the user will interact with the system i.e. starting with recording video and ending with getting a summary of the presentation skills. D.Y.P.C.O.E., Akurdi, Pune 35 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Figure 7.3: Interaction Diagram 7.4.3 Algorithms Support Vector Machines or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning.The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. Random Forest ALgorithm is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model. D.Y.P.C.O.E., Akurdi, Pune 36 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 8 Project Implementation 8.1 Introduction The farmer face the issue of lesser crop yield, due to improper crop pattern, less resources and many of such factors. The goal here is to solve this problem, by creating platform where user (in this case farmer) can sign in ,get proper analysis reports for his land/crop .Also, along with that platform focuses on developing common communication medium of farmers,investors,retailers market and government, which will centralize the agriculture department 8.2 Tools and Technologies Used Tools: 1. Visual Studio Code 2. Jupyter Notebook Technologies: 1. Machine Learning 2. Flask API 8.3 Methodologies/Algorithm Details 8.3.1 SVM Support Vector Machinesare a maximal margin hyperplane classification method that relies on results from statistical learning theory to guarantee high generalization performance. D.Y.P.C.O.E., Akurdi, Pune 37 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Figure 8.1: SVM Diagram 8.3.2 Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset.” Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output. Figure 8.2: Random Forest Algorithm D.Y.P.C.O.E., Akurdi, Pune 38 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 9 Software Testing 9.1 Test Cases Test Case 1: Application starting after entering url. Test Case 2: Input entries validation. Test Case 3: Fetching the results using result tab . Test Case 4: Show textual and graphical result. Test Case 6: Application closing on clicking close tab. D.Y.P.C.O.E., Akurdi, Pune 39 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 10 Conclusion and Future Scope 10.1 Conclusion • In this project, are implementing Crop yield Prediction and Analysis for enabling farmers to take optimal decision. • SVM and Random Forest Algorithm are two main algorithms under consideration. 10.2 Future scope 1. Real time Prediction 2. Time Series Analysis and Market Comparision UI. D.Y.P.C.O.E., Akurdi, Pune 40 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction 11 Bibliography [1] Thomasvan Klompenburg,AyalewKassahun,Cagatay Catalb, “Crop yield prediction using machine learning: A systematic literature review.” ,Elsevier,Computers and Electronics in Agriculture Volume 177, October 2020, 105709 [2] V. Sellam, E. Poovammal “Prediction of Crop Yield using Regression Analysis” in 4th Int. 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S, “Performance Evaluation of Best Feature Subsets for Crop Yield Prediction Using Machine Learning Algorithms”, 05 Apr 2019 D.Y.P.C.O.E., Akurdi, Pune 44 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Laboratory assignments on Project Analysis of Algorithmic Design The algorithms used for crop prediction will be mainly consisting of SVM and Random Forest Algorithm. Support Vector Machine The svm algorithm takes high variance i.e. there are chances of over fitting and also the more number of input features make it time complex. But here the svm is to be implemented in such way that there will be less number of features to avoid over-fitting and thus recommending crops in better way. Random Forest Algorithm Also ,the random forest improves the accuracy and performance by using Divide and conquer strategy that surpasses Decision tree algorithm ,by considering more trees and selecting the best out of one. D.Y.P.C.O.E., Akurdi, Pune 45 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Laboratory assign. on Project Quality and Reliability Testing of Project Design As the approach followed in project is predictive analysis,there is in deed reliability issues,as if there is lot of noise in training dataset ,the output result produced might be not the optimal one. Also as mentioned above ,if the result is not upto mark,it may certainly deprive the quality of project. As well as project has algorithms which does not require strong and fast computation power unlike deep learning techniques,hence in terms of computation complexity is will be more faster D.Y.P.C.O.E., Akurdi, Pune 46 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Project Planner Module status Remarks Requirement Analysis Done Data Collection/Analysis Done Model Generation Started Will be completed by January Testing Will be completed by January UI Design In operation Will be completed by February Documentation In operation Will be completed by March Table : Project Planner D.Y.P.C.O.E., Akurdi, Pune 47 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Reviewers Comments of Paper Submitted 1. Paper Title: 2. Name of the Conference/Journal: 3. Paper Accepted/Rejected: 4. Review comments by reviewer: 5. Corrective actions (if any): D.Y.P.C.O.E., Akurdi, Pune 48 Department of Computer Engineering B.E. Project Machine Learning Techniques For Crop Yield Prediction Appendix Plagiarism Report D.Y.P.C.O.E., Akurdi, Pune 49 Department of Computer Engineering B.E. 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