INTELLIGENT CROP RECOMMENDATION SYSTEM USING MACHINE LEARNING

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Abstract

Agriculture is a major contributor to the Indian economy. The common problem existing among the Indian farmers are they don't choose the right crop based on their soil requirements. Due to this they face a serious setback in productivity. This problem of the farmers has been addressed through precision agriculture. Precision agriculture is a modern farming technique that uses research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their site-specific parameters. This reduces the wrong choice on a crop and increases the productivity. In this project, we are building an intelligent system, which intends to assist the Indian farmers in making an informed decision about which crop to grow depending on the sowing season, his farm's geographical location and soil characteristics. Further the system will also provide the farmer, the yield prediction if he plants the recommended crop

Introduction

A farmer's decision about which crop to grow is generally clouded by his intuition and other irrelevant factors like making instant profits, lack of awareness about market demand, overestimating a soil's potential to support a particular crop, and so on. A very misguided decision on the part of the farmer could place a significant strain on his family's financial condition. Perhaps this could be one of the many reasons contributing to the countless suicide cases of farmers that we hear from media on a daily basis. In a country like India, where agriculture and related sector contributes to approximately 20.4 per cent of its Gross Value Added (GVA) [2], such an erroneous judgment would have negative implications on not just the farmer's family, but the entire economy of a region. For this reason, we have identified a farmer's dilemma about which crop to grow

during a particular season, as a very grave one. The need of the hour is to design a system that could provide predictive insights to the Indian farmers, thereby helping them make an informed decision about which crop to grow. With this in mind, we propose a system, an intelligent system that would consider environmental parameters (temperature, rainfall, geographical location in terms of state) and soil characteristics (pH value, soil type and nutrients concentration) before recommending the most suitable crop to the user.

Existing System

Existing System More and more researchers have begun to identify this problem in Indian agriculture and are increasingly dedicating their time and efforts to help alleviate the issue. Different works include the use of

Regularized Greedy Forest to determine an appropriate crop sequence at a given time stamp. Another approach proposes a model that makes use of historical records of meteorological data as training set. Model is trained to 1 Intelligent Crop Recommendation System using ML Chapter 1 identify weather conditions that are deterrent for the production of apples. It then efficiently predicts the yield of apples on the basis of monthly weather patterns. The use of several algorithms like Artificial Neural Network, K Nearest Neighbors, and Regularized Greedy Forest is demonstrated in to select a crop based on the prediction yield rate, which, in turn, is influenced by multiple parameters. Additional features included in the system are pesticide prediction and online trading based on agricultural commodities.

DRAWBACK

One shortcoming that we identified in all these notable published works was that the authors of each paper concentrated on a single parameter (either weather or soil) for predicting the suitability of crop growth. However, in our opinion, both these factors should be taken together into consideration concomitantly for the best and most accurate prediction. This is because, a particular soil type may be fit for supporting one type of crop, but if the weather conditions of the region are not suitable for that crop type, then the yield will suffer.

Proposed System

We to eliminate the aforementioned drawbacks, we propose an Intelligent Crop Recommendation system- which takes into consideration all the appropriate parameters, including temperature, rainfall, location and soil condition, to predict crop suitability. This system is fundamentally concerned with performing the primary function of Agro Consultant, which is, providing crop recommendations to farmers algorithms.We also provide the profit analysis on crops grown in different states which gives the user an easy and reliable insight to decide and plan the crops. Plan of Implementation The steps involved in this system implementation are:-

a) Acquisition of Training Dataset:The accuracy of any machine learning algorithm depends on the number of parameters and the correctness of the training dataset.For the system, we are using various datasets all downloaded for government website and kaggle. Datasets include:- Cost of cultivation per ha dataset for major crops in each state Yield dataset Dept Of ISE, CMRIT, Bengaluru - 560037 2 Intelligent Crop Recommendation System using ML Chapter 1 Modal price of crops Standard price of crops Soil nutrient content dataset Rainfall Temperature dataset b) Data Preprocessing: This step includes replacing the null and 0 values for yield by -1 so that it does not effect the overall prediction.Further we had to encode the data-set so that it could be fed into the neural network. c)Training model and crop recommendation:After the preprocessing step we used the data-set to train different machine learning models like neural network and linear regression to attain accuracy as high as possible. 1.5 Problem Statement Failure of farmers to decide on the best suited crop for his land using traditional and non-scientific methods is a serious issue for a country where approximately 50 percent of the population is involved in farming.Both availability and accessibility of correct and up to date information hinders potential researchers from working on developing country case studies.With resources within our reach we have proposed a system which can address this problem by providing predictive insights on crop sustainability and recommendations based on machine learning models trained considering essential environmental and economic parameters.

Agriculture is one of the major sources of livelihood for about 58% of our nation's population. As per the 2016-17, Economic survey the average monthly income of a farmer in 17 states is Rs.1700/- which results in farmer suicides, diversion of agricultural land for non-agricultural purpose. Besides, 48% of farmers don't want their next generation to take care of their agriculture instead want to settle down in urban areas. The reason behind this is that the farmers often take wrong decision about the crop selection for example selecting a crop that won't give much yield for the particular soil, planting in the wrong season, and so on. The farmer might have purchased the land from others so without previous experience the decision

might have been taken. Wrong crop selection will always result in less yield. If the family is fully dependent on this income then it's very difficult to survive.

in existing system we used random forest algorithm.but we cannot predict exact recommended crop.

Machine learning

Machine learning is an application of artificial intelligence (AI) that gives systems the ability to automatically learn and evolve from experience without being specially programmed by the programmer. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The main aim of machine learning is to allow computers to learn automatically and adjust their actions to improve the accuracy and usefulness of the program, without any human intervention or assistance. Traditional writing of programs for a computer can be defined as automating the procedures to be performed on input data in order to create output artifacts.

Almost always, they are linear, procedural and logical. A traditional program is written in a programming language to some specification, and it has properties like: • We know or can control the inputs to the program. • We can specify how the program will achieve its goal. • We can map out what decisions the program will make and under what conditions it makes them. • Since we know the inputs as well as the expected outputs, we can be con dent that the program will achieve its goal Traditional programming works on the premise that, as long as we can define what a program needs to do, we are confident we can define how a program can achieve that 6 Intelligent Crop Recommendation System using ML Chapter 3 goal. This is not always the case as sometimes, however, there are problems that you can represent in a computer that you cannot write a traditional program to solve. Such problems resist a procedural and logical solution. They have properties such as: • The scope of all possible inputs is not known beforehand. • You cannot specify how to achieve the goal of the program, only what that goal is. • You cannot map out all the decisions the program will need to make to achieve its goal. • You can collect only sample input data but not all possible input data for the program

System Analysis

 Feasibility Study Analysis is the process of finding the best solution to the problem. System analysis is the process by which we learn about the existing problems, define objects and requirements and evaluates the solutions. It is the way of thinking about the organization and the problem it involves, a set of technologies that helps in solving these problems. Feasibility study plays an important role in system analysis which gives the target for design and development.

Economical Feasibility This study is carried out to check the economic impact that the system will have on the organization. Since the project is Machine learning based, the cost spent in executing this project would not demand cost for softwares and related products, as most of the products are open source and free to use. Hence the project would consumed minimal cost and is economically feasible.

Technical Feasibility This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Since machine learning algorithms is based on pure math there is very less requirement for any 17 Intelligent Crop Recommendation System using ML professional software. And also most of the tools are open source. The best part is that we can run this software in any system without any software requirements which makes them highly portable. Also most of the documentation and tutorials make easy to learn the technology

Social Feasibility The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The main purpose of this project which is based on crop prediction is to prevent the farmer from incurring losses and improve productivity. This also ensures that there is no scarcity of food as lack of production may lead to severe consequences. Thus, this is a noble cause for the sake of the society, a small step taken to achieve a secure future.

Analysis

Performance Analysis Most of the software we use is open source and free. The models which we use in this software, learn only once ,i.e once they are trained they need not be again fed in for the training phase. One can directly predict

for values, hence time-complexity is very less. Therefore this model is temporally sound.

Technical Analysis As mentioned earlier, the tools used in building this software is open source. Each tool contains simple methods and the required methods are overridden to tackle the problem.

System Design

System Development Methodology System Development methodology is the the development of a system or method for a unique situation. Having a proper methodology helps us in bridging the gap between the problem statement and turning it into a feasible solution. It is usually marked by converting the System Requirements Specifications (SRS) into a real world solution. System design takes the following inputs: • Statement of work. • Requirement determination plan. • Current situation analysis. • Proposed system requirements including a conceptual data model and metadata (data about data).

Model Phases The waterfall model is a sequential software development process, in which progress is seen as owing steadily downwards (like a waterfall) through the phases of Require- ment initiation, Analysis, Design, Implementation, Testing and maintenance. 20 Intelligent Crop Recommendation System using ML Chapter 6 Requirement Analysis: This phase is concerned about collection of requirement of the system. This process involves generating document and requirement review. System Design: Keeping the requirements in mind the system specifications are translated in to a software representation. In this phase the designer emphasizes on:- algorithm, data structure, software architecture etc. Coding: In this phase programmer starts his coding in order to give a full sketch of product. In other words system specifications are only converted in to machine

DISADVANTAGES OF EXISTING SYSTEM:

- Low Efficiency.

- We cannot predict the recommended crops.
- In existing system we cannot used any deep learning algorithms.

Algorithm: Random Forest

REQUIREMENT ANALYSIS

The project involved analyzing the design of few applications so as to make the application more users friendly. To do so, it was really important to keep the navigations from one screen to the other well ordered and at the same time reducing the amount of typing the user needs to do. In order to make the application more accessible, the browser version had to be chosen so that it is compatible with most of the Browsers.

REQUIREMENT SPECIFICATION

Functional Requirements

- Graphical User interface with the User.

Software Requirements

For developing the application the following are the Software Requirements:

1. Python
2. Django

Operating Systems supported

1. Windows 10 64 bit OS

Technologies and Languages used to Develop

1. Python

Debugger and Emulator

- Any Browser (Particularly Chrome)

Hardware Requirements

For developing the application the following are the Hardware Requirements:

- Processor: Intel i9
- RAM: 32 GB
- Space on Hard Disk: minimum 1 TB

SYSTEM TEST

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

1) *TYPES OF TESTS*

Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration.

Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Functional test

 Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input		: identified classes of valid input must be accepted.

Invalid Input		: identified classes of invalid input must be rejected.

Functions		: identified functions must be exercised.

Output			: identified classes of application outputs must be exercised.

Systems/Procedures	: interfacing systems or procedures must be invoked.

 Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

System Test

 System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

Unit Testing

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

Test objectives

- All field entries must work properly.
- Pages must be activated from the identified link.
- The entry screen, messages and responses must not be delayed.

Features to be tested

- Verify that the entries are of the correct format
- No duplicate entries should be allowed
- All links should take the user to the correct page.

II.   INTEGRATION TESTING

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

INPUT AND OUTPUT DESIGN

INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

OBJECTIVES

1.Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process

and show the correct direction to the management for getting correct information from the computerized system.

2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

3.When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow

OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2. Select methods for presenting information.

3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- Convey information about past activities, current status or projections of the
- Future.
- Signal important events, opportunities, problems, or warnings.
- Trigger an action.
- Confirm an action.

CONCLUSION

The proposed system helps the farmers to choose the right crop by providing insights that ordinary farmers don't keep track of thereby decreasing the chances of crop failure and increasing productivity. It also prevents them from incurring losses. In the future, it has been planned to incorporate a web interface as well as a mobile app to provide the recommendations of crop cultivation to the farmers can be accessed by millions of farmers across the country.

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