Farmer's Adviser System

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Abstract

About 64.14 per cent of the people of Maharashtra state are employed in agriculture, but it's contribution towards the GSDP of Maharashtra is only 12.5 per cent. One possible reason for this poor contribution is the lack of sufficient crop planning by farmers. In this paper we try to predict crop yield and price that a farmer can obtain from his land. For this we analyze the patterns in past data and use sliding window non-linear regression technique based on different factors affecting agricultural production such as temperature, rainfall, area of land, market prices and previous crop taken in farm. Our system intends to suggest the best crop choice and income from the crop for a farmer in order to reduce the common socio-socio-economic issues facing many farmers today.

Keywords- Agriculture, Data Analysis, Prediction Algorithms, Regression Analysis

I. INTRODUCTION

A possible reason for the poor contribution of the agricultural sector to the GSDP of Maharashtra may be the lack of sufficient crop planning by farmers as well as by the government. Continuous fluctuations in the market prices are common. In such a case, it is difficult for a farmer to make a choice of crop to grow in his land or to estimate the yield and price to expect from it. The aim of our work is to help the farmer by applying predictive analytics on data in previous years and maintain the accuracy by using nonlinear regression algorithm [1].

Data analytics is a process of examining data sets in order to draw conclusions about the information. There are some processes in data analytics – data requirements collection of data, cleaning, transforming and modeling of data. Finally, algorithms are applied to the available data to discover relations between variables.

In the process of analysis, after collection of data different ways are used for manipulation of data such as plotting, pivot table creation and finding correlations with the aim of finding some useful patterns. Regression analysis is a form of predictive modeling technique which investigates the relationship between a dependant and independent variable. It also used for finding relationship between the variables. Curve fitting operations are the part of data analysis. In this work, we apply regression modeling to build a Farmer's Adviser system.

To find an algorithm for regression, there are some linear regression methods such as multiple linear regression [2], online ridge regression [3] and stochastic gradient descent [4]. Key element of each of them are integrated into the design of the prediction algorithm in Farmer's Adviser system. These algorithms work on the basis of reducing the least square difference between the curve and actual data values. A linear regression technique would not sufficient for our agriculture database because the yield and price depend on several parameters. A nonlinear regression algorithm [6] is used to find the best fit curve.

The sliding window nonlinear regression method is used to find the relation between given two variables in Farmer's adviser system. In this technique we take the window size equal to the time for crop to grow. In the case of agriculture rainfall and temperature has a strong influence on the amount of production. We analyze the rainfall pattern for the period that a crop takes to grow. This pattern is derived for the current year in order to find the expected yield. A Taylor series approximation algorithm is used in this system because this algorithm guarantees sufficiently smooth function that can fit the graph points well. Initially many graphs are plotted and the graph with least variance is selected. In grey method the prediction of the production price is done for a time span of one year. But in farmer's adviser system, the data is considered over 10 years and also provide a flexible and extensible framework for agricultural crop yield prediction [7].

The farmer's adviser system provides suggestions for a given farmer by various parameters.

II. WORKING OF SYSTEM

The first need was to collect sufficient data to enable accurate analytics. Different database are required (i) temperature data, (ii) rainfall data, (iii) production data and (iv) price data of each crop in different talukas .The dataset were cleaned and integrated to give us a consistent dataset perform analytics.

Data cleaning is one of the first and most important steps in any data processing task. Data cleaning verify that the data values in dataset are correct. There were some cleaning operations perform on the datasets to obtain accurate results [8]:

1) Check for the missing values and replace it with either default values.
2) Remove and replace the improper format entries.
3) Handle inconsistencies in the data.

Farmer's Adviser system consists of following components:

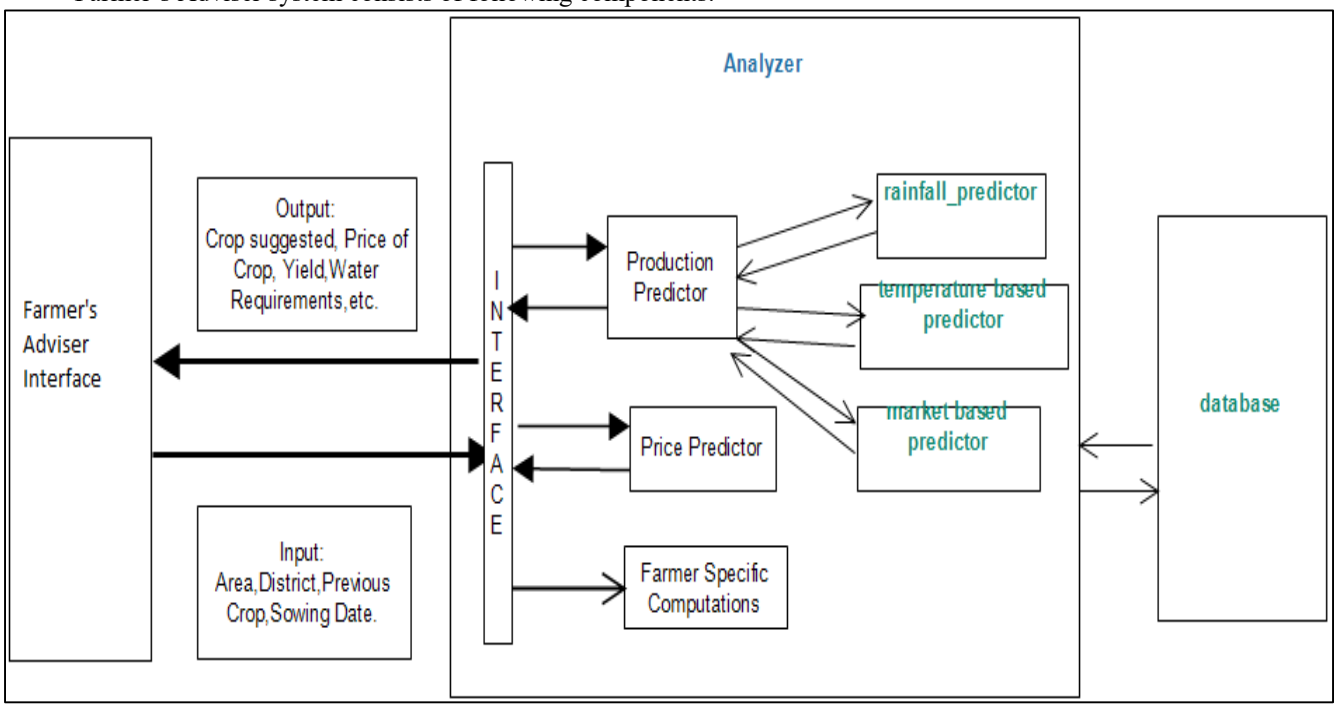

Fig. 1: Architecture of Farmer's Adviser System

A. User interface

Farmer interact with the system through the Farmer's Adviser interface. We are providing a web interface to the system. Initially, farmer can login to our website and provides the following inputs:

- Area of the land,
- Taluka in which the farm is located,
- Previous crop,
- Sowing date.

B. Analyzer

The inputs provided by the farmer are pass to the analyzer and different operations are perform on the data by fetching the data from the database. The results of these calculations are provided to the user interface in the form of ranked list of crops that farmer can grow in his farm to achieve maximum profit. For each crop we have different attributes –

- Name of the crop
- Expected price
- Expected yield
- Rainfall and irrigation requirement
- Soil requirement
- Temperature

The analyzer consists of following components:

1) Interface

Interface is the module that acts as the interface to the user interface. It takes the input provided by the farmer and directs it to the different modules for further computation. Interface also takes the output of the computation and forwards it to the user interface.

2) Production Predictor

From the interface, the control is first passed to the production predictor. The main function of this module is to make the correlation between production and the different factors on which it depends. In our implementation we have modules for rainfall, temperature and previous price dependencies. Each of these modules return the production value which is also called as final production and these final productions are passed as a result to the interface.

3) Price Predictor

This module takes the predicted production as input and applies non-linear regression to obtain the pattern in which price in market depends on amount of yield produced. Price predictor computes the price and this computed price is return to the interface.

4) Farmer Specific Computations

Once we get the predicted produce and price for the crop, the control is passed to this module. This is the final output of our system which gives the ranked crop list and income from that crop.

5) Database

For quick access of data the all available datasets are stored in suitable schema in the database

III. ALGORITHM AND IMPLEMENTATION

The calculation of various predictions begins with the formulation of the non-linear least- squares fit line. The non-linear least-square fit makes use of non-linear model to fit a set of observations.

A. Support Vector Regression

Steps:

1) Start
2) Input- area of land, taluka, expected sowing date.
3) Process- Mapping of given inputs with previous stored data on the database.
4) Output- production1, production2, production3 lists from observing the inputs.

production1 = Rain based predictor.
production2 = Temperature based predictor.
production3 = Previous price based predictor.

5) output is given to the interface for further processing
6) end.

B. Non-Linear Regression

Steps:

1) Start
2) Input production1, production2, production3.
3) Process-

Consider a non-linear model,
Start
2) Input production1, production2, production3.
3) Process-
Consider a non-linear model,

$$Y = f(X, \Theta) + £$$

[1] Where, Y represents the data to be modeled.
X is the independent variable.
Θ is the model parameter.
£ is residual or errors.
Next step is the chi-square minimization.

$$X^2 = \Sigma\, [(Yi - f(xi', \Theta^\wedge)) / \sigma_i]^2$$

[1] Where, σ_i is standard deviation.
Iterations are employed to estimate the parameter values.
Non-linear model employed for the prediction is-

$$F(P1, P2, x) = P1 \cos(P2x) + P2 \sin(P1x)$$

[1] With each iteration X^2 value is calculated.
Parameter values are adjusted to reduce X^2

4) Output - Crop ranking and expected value.
5) end.

1) Rainfall Prediction

From the rainfall dataset we can get direction for finding the rainfall pattern. The production of a specific crop in a taluka is plotted against the rainfall in that taluka. This pattern is derived and the expected yield for the crop in next season is determined. This yield is act as production1 in our future reference.

2) Temperature Prediction

From the temperature dataset we can get direction for finding the temperature pattern. The production of a specific crop in a taluka is plotted against the temperature in that taluka. This pattern is derived and the expected yield for the crop in next season is determined. This yield is act as production2 in our future reference.

3) Previous Crop Price

The crop prices in the market has great impact on the farmers to grow that particular crop in their farm. The production of a specific crop in a taluka is plotted against the previous crop price. This pattern is derived and the expected income for the crop in next season is determined. This is act as production3.

4) Final Production

Using the production values obtained in the previous modules, we take a weighted sum of all the three depending upon their influence on the production.

Sr. No	Dependency Factor	Weight
1)	Rainfall	50%
2)	Previous price	35%
3)	Temperature	15%

5) Finding the Price of Crop

Using the final production value, we plot dependency between production and price, and find out the optimum price of that crop.

6) Finding Farmer Specific Details

The price and production of the crop are computed according to the farmer's area of land using various factors.

IV. RESULT

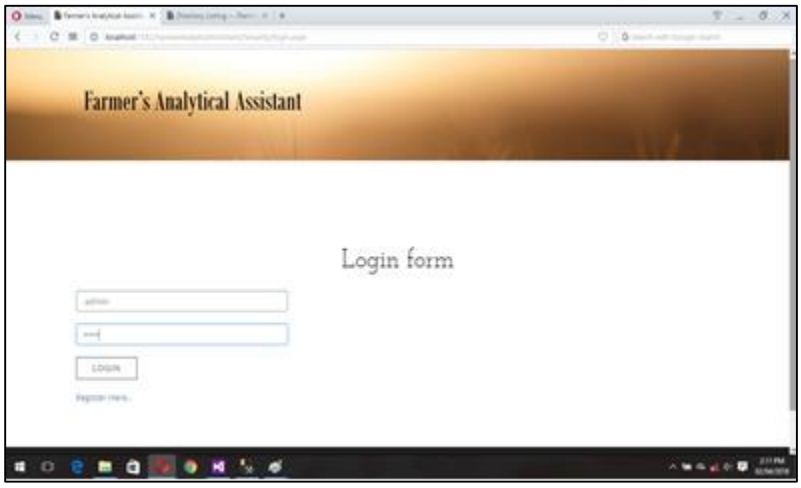

Fig. 2: Login Form

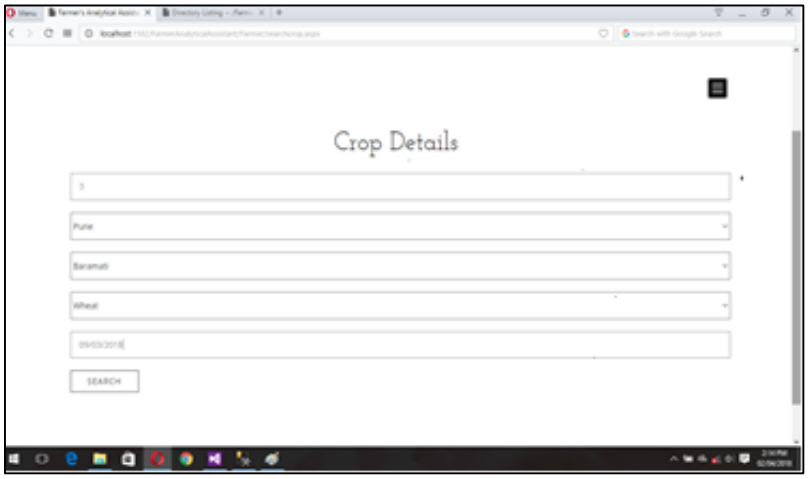

Fig. 3: Crop Details

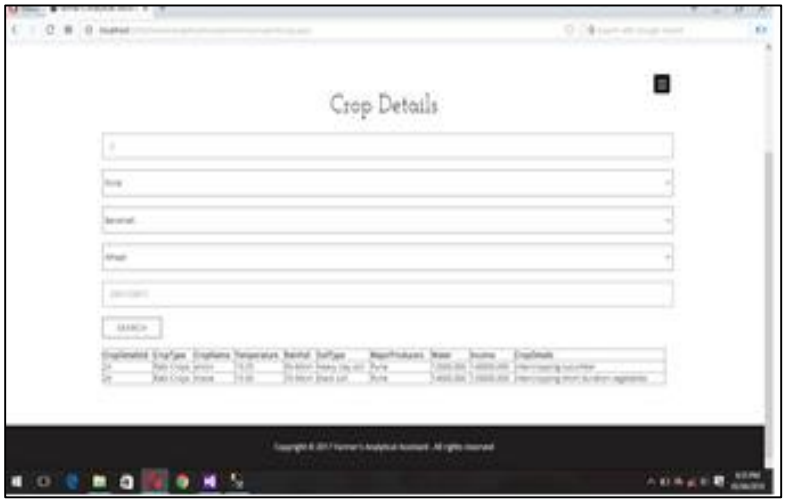

Fig. 5: Final Result

V. CONCLUSION

Farmer's adviser system help to the farmers by suggesting the best crop choice to get maximum yield and from that yield farmer can get maximum income.

We use non-linear regression algorithm in our system which helps to increase the accuracy of system. Also we analyze the past data such as rainfall, temperature, market prices by using support vector regression.

VI. FURTHER ENHANCEMENTS

1) We have covered talukas in Maharashtra. We hope to extend Farmer's Adviser system to whole of India.
2) Data is available only for few crops. Many crops are yet to be added to the system.
3) The suggestion for intercropping can also be added to increase productivity.

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