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Grain Market Trade Benefit to Farmer via Forecast Estimation

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Abstract— The impact of climate changes, the crops that are used to be grown by the farmers procedurally over the whole year has changed, now if the procedure is followed, the crops yields are not up to the mark, which further puts the farmers in the loss. The major problem currently perpetuating in the Indian Market is the value Prediction for varieties of crops in the market. We will build a prediction web app to tackle these problems, which will suggest what to grow and when to grow. The farmer shall be provided with some tools comprising of Ph, moisture sensors, etc. which will be connected to the Mobile App and the data shall be fetched out from cloud database, next the data cleaning will be done following machine learning techniques, focusing on optimizing the Decision Tree Regressor using Scikit tools. About 80% of data will be used for training and the remaining 20% of data will be used to test the prediction model. Other technologies such as chart.js, NumPy, JavaScript, Bootstrap, etc. shall be used according to the requirement. Finally, the result shall be presented to the farmer in the GUI Interface.

Index Terms— Climate, Sensors, GUI, Machine Learning, Prediction, Decision Tree Regression, Scikit tools.

1 INTRODUCTION

1.1 Theoretical Background

The effect of environmental changes, the harvests that are utilized to be grown by the ranchers in a procedural manner over the entire year has changed. Presently, if the same procedures are followed up, the crop yields will be insufficient, which eventually puts the ranchers in misfortune and loss. To handle such issues, we will fabricate an expectation web application that will suggest what to grow and when to grow. A significant problem that is perpetuating in Indian market is the worth prediction for assortments of harvests. In the modern days of Science and Technology, it's significant for every one working in the various fields has to advance with continuous advances. In later occasions, the analysts learning at different schools and colleges commit their lives to imaginative work of developing things and practices. Ranchers have benefitted and added to the reliably creating investigation of cultivating. In this undertaking, we target assisting the rancher with having an exchange advantage at Grain Market utilizing conjecture data. The majority of the occasions, the rancher is dealing with issues of selecting the sort of harvest to be grown to have the most elevated benefit. However, the problem cannot just be restricted to this as to consider a case in some cases. Regardless of whether the yield has high market interest, yet the quality is not acceptable in some cases which further prompts the rancher in the red. So the mix of the two things, i.e., picking the best harvest as per the current soil pH, temperature, dampness, and precipitation, helps choose the best harvest for development. Further, the rancher will likewise approach the anticipated cost for the yield in the coming months, so the rancher can utilize the data, consequently choosing the best harvest to develop. We will give the finished result a Mobile Web App since a portable application is not difficult to work in any event for an individual with less technical information on operating the Smartphone. The rancher will be given a few devices involving Ph, dampness and different sensors which are associated with the Mobile App and the information will be used from the cloud data set. Next, we will play out the information cleaning followed by AI strategies, will zero in on upgrading the Decision Tree Regressor utilizing Scikit apparatuses. We will utilize 80% of information for training and the other 20% of information for testing the prediction model. The prerequisite will utilize different advancements, such as chart.js, NumPy, JavaScript, Bootstrap, etc. At long last, the outcome will be introduced to the rancher in the GUI Interface.

1.2 Motivation

1.2.1 Technical

In today's science and technology era, all the different fields need to progress with the ongoing technologies. In recent times, researchers learning at various colleges and universities have dedicated their lives to the innovative work of cultivating items and practices. Farmers have profited and added to the consistently developing study of farming. In this project we aim at helping the farmer have a trade benefit at Grain Market via forecast information. Most of the time, the farmer is facing problems of choosing the type of crop to be grown to have the highest profit. Still, the problem can't only be limited to this as considered a case even if the crop grown has high market demand. Still, the quality is not good which further leads to the farmer in debt, so a combination of the two things i.e., choosing the best crop according to the current soil pH, temperature, moisture and rainfall help in choosing the best crop for cultivation. Further the farmer will also have access to the predicted price for the crop in coming months, so the farmer can use the information thus provided deciding the best crop for cultivation. We will be presenting the end product with a Mobile Web App since the mobile app is easy to operate even for a person with less technical knowledge on operating the Smartphone. The farmer shall be provided with some tools comprising of Ph, moisture etc. sensors which will be connected to the Mobile App and the data shall be fetched from cloud database, next we shall be performing the data cleaning followed by machine learning techniques, will focus

on the optimizing the Decision Tree Regressor using Scikit tools. We will be using 80% data for training and remaining 20% data for testing. Other technologies such as chart.js, NumPy, JavaScript, Bootstrap etc. shall be used according to the requirement. Finally, the result shall be presented to the farmer in the GUI Interface.

1.2.2 Environmental

The environmental aspect of the project is also put into consideration while developing the project. Since the crop shall be predicted beforehand which suits the best for the current ecological conditions, the farmer not has to unnecessarily spend money on buying the fertilizers and putting on the soil, which usually degrades the quality of the soil in long run. Also, in case previously the farmer grew the crop according to his mind, which lead to less quality production. Moreover, not being able to be sold the product in the market as it requires packaging material. Sometimes, crops left for a long time in storage areas were also degraded by the environmental forces acting. So, in all this will also help in development to the ecological aspect as well.

1.2.3 Economical

This project mainly aims to prevent the economic loss of its user, as we know that due to the continuous changes in the climate of our country, the crops procedurally grown by the farmers over the whole year have faced a drastic change. This model suggests us that if our farmers continue to follow the fashion, the crop yields will not be up to that mark. Therefore, forecasting the market cost of grains in advance will let the farmers decide the things more to marketing and the type of crop to produce and store beforehand. The product will try to collect the data of moisture, temperature and other items of the field through the sensors and Arduino circuit and will create a dataset along with the previous price datasets to calculate which crop to grow for the farmer in the most minimal possible cost.

1.2.4 Social

Due to social influence, the farmers are improving their traditional farming by accepting new technology. However, there is an argue relation that is total 'myths' or simplifications that the farmers sometimes do not accept the new technologies. Therefore, it requires public awareness around farmers to accept new technology. Time requires to increase grain production with an increase in population. So, that farmers, as well as people, can get benefits. Farm transitions are influenced by farm family dynamics, sociocultural values, land tenure, succession, and community factors in addition to economic conditions. It includes wealth, religion, buying habits, education level, family size and structure and population density.

1.2.5 Political

There are many political factors on today's farming like: Government policy, political stability or instability, bureaucracy, corruption, competition regulation, foreign trade policy, tax policy, trade restrictions, labor, environmental, copyright, consumer protection laws, funding grants & initiatives, etc.

2 Literature Review

[1] contributed to remote sensing domain for predicting crop yield of different crops in the Australian crop farming areas. They devised a new technique called C-Crop for crop yield production, making use of crop type, foliage length cover, air temperature, etc. some of the inputs are fed via remote sensing like air temperature and other locally such as foliage length cover, etc. the data which they used for processing is yield data as that of canola and wheat of respectively 31 field years and 160 field years, which is used for further prediction of the crop yield i.e., for forecasting. The improvements in relation to our study being we aim to focus on a no. of important factors i.e., soil pH, humidity, rainfall, etc. important factors, also no analysis has been given to crop prices.

[2] focus on crop yield forecast comprising of different methods and accuracies. The author discusses about various statical methods, agrometeorological techniques for predicting the crop yield, the author also discusses that the predictions usually have some error, which the author suggest to have a combination of statical and agrometeorological both to have a better prediction. Accuracy is totally defined on the quality of the data received. In relation to the conclusion, the data quality as received from our model, from different IOT devices in Realtime would lead to high accuracy calculations.

[3] discusses about different machine learning techniques to have a maximum output for the crop yields and help the farmers. The data used I this is collected from Polyset Laboratories testing lab, collected from different areas. Then this data is used for further analysis using different machine leaning techniques such as Support Vector Machine, Naïve Bayes, Random Forest etc. The limitations to the paper being that it mostly focuses on soil, other parameters like temperature, humidity, etc. are not put into consideration, which form important parameters while calculation, the same are developed as improvements to our research.

[4] focuses on recommending the crops, since the majority of the problem in India being that the farmer doesn't know what crop to grow in order to have the highest yield and have the highest amount paid for their yield in order to have the highest profit, but since due to unknown climatic, temperature, soil changes the usual cycle doesn't follow, this paper aims at solving this issue. The paper uses different machine learning technique like Naïve Bayes, SVM etc for its prediction of the crop to be grown. In conclusion to our development, we also aim to provide the farmer an idea to the price of the crops in the upcoming future, helping the farmer to get a beforehand idea of crop grown in addition to predicted price.

The authors [5] have tried to demonstrate their work which they have carried out by using IOT devices, & Data Mining techniques to predict the crop yield. Mainly they are acquiring data through their sensing devices and processing and delivering it to cloud with the help of IOT devices e.g., microcontrollers and Arduinos. After consolidating these data, they are feeding to a user generated site and getting the estimation. While Our Project will be auto fetching the processed data and gathering some real-time data like weather, humidity, rain prediction, etc., which are available at the meteorologi-

cal department and then processing these data through ML algorithm will produce a prediction in both yield and local market rate. Their solution is constrained to a limited location and limited geographical areas while our solution is not constrained to a particular place or a geographical area. Moreover, it would be a Global Solution.

The authors [6] have tried to give a solution using ML, Deep Learning & Image Processing, and Neural Networks. They are trying to get images as input data to train and analyze their model from different federal agencies working in the field of agriculture, surveys, and meteorology. Well, we find this solution more of theoretical nature rather than practical results. A model cannot just analyze pixels of the images taken from satellites and estimate the yield. While taking this ideological approach, we have chosen an efficient and feasible approach of analyzing real-time data and then conclude a result.

The authors [7] have performed a location-centric study to develop an index using other indices named NDVI & VCI. They are acquiring data from 8 kmX8 km NDVI datasets from advanced technologies like Advanced very High-Resolution Radiometer (AVHRR) National Oceanic and Atmospheric Administration (NOAA). These are very advanced technologies being used here, and results are not very precise everything is based on statistics and a probabilistic approach. While we are processing the results with much precision, our results are most concluding and easier to interpret by humans. A review paper [8] is presented to notice the issue and find a solution by using various machine learning algorithms like K-NN, SNN, CNN & c-means and k-means algorithms by taking Nitrogen and its management as key elements. They are using management zones and clustering data explicitly for unsupervised learnings. Also, they are sensing level of nitrogen in soil, plants and their roots and accepting this data as in-situ remote sensing. Well, this is a novel approach we have found in this paper. We will include it in our future scopes, but focusing on only one component of nutrition or micronutrition is not a good idea. Rather, analyzing all the components of nutrition would be a good Idea. We shall incorporate this point in our project for more precision.

In the paper [9], the model Suggested by Fisher (1924) and Hendrick and Scholl (1943), which has further been modified at Indian Agricultural Statistics Research Institute (IASRI), where partial crop season data considering different weather variables simultaneously to develop a forecast model. The result showed that 92% of yield of kharif Rice have been contributed mainly by Midnapur(west) and the performance of the model in predicting yields at the district level for various crops across the country is quite satisfactory. This Project differs from us as we aim to get the datasets of a particular land across any part of the country. This has covered the scenario and climatic situations of West Bengal Only.

[10] describes the forecast of crop yield is done on the variability of weather. Model-based on the weather parameters can be used for reliable forecasts in advance for crop yield. This research paper has used stepwise regression analysis. Here Weather variables are taken as independent variables as these have a great impact on the crop yield and time function as another parameter to relate with technology. The outcome illustrates that the statistical models based upon the pre harvest yield forecast under semi-arid region for wheat can be simulated successfully. The deviation between observed and simulated yield was found in a range of 5 to 11 and its correlation coefficient was found as 0.93 to 0.99. Proposed advantages of this model are that it is simple, no sophisticated tools are required and can be used to investigate district level agro-climatic zone and state level forecast. This project mainly aims to forecast through weather conditions of a particular region where we will consider factors like earlier costing datasets, moisture, temperature etc. through our IOT devices.

[11] the problem of increased temperature and decreased soil moisture has been solved through the direct fertilization effect of rising carbon dioxide concentration. Free-air concentration enrichment (FACE) technology has been used to facilitate trials of the major grain crops at elevated under fully open-air field conditions. A typical FACE apparatus consists of a 20-m-diameter plot within the crop field in which CO2 is released just above the crop surface on the upwind side of the plot. These systems have been engineered so that they can operate continuously from sowing to harvest and maintain [CO2] within the plot to within T10% of the target level. The FACE experiments illustrate that much lower CO-fertilization factors should be used in model projections of future yields, but a disadvantage to this paper is that the interactive effects of simultaneous change in CO2, O3, temperature and soil moisture has not been investigated.

[12] there are various approaches for forecasting crop yield and forewarning issued which enable the farmers to optimize plant protection measures. Various models such as Yield forecast models, models with composite weather variable, discriminant function analysis, water balance technique, ordinal logistic model, deviation method and artificial neural network technique. This paper also focuses on forewarning of pests and diseases using qualitative data model. This model can be used even in the lack of availability of detailed and exact datasets. Apart from all of the models proposed, the ANN model is considered best for the forewarning of crop yield. To sum up, various models were designed at IASRI in order to forecasting crop yield and forewarning pests and diseases. The performance found to be good. The methodologies were used successfully by various other workers and organizations. This paper has forecast the outcome through a variety of models, where as we are implementing a subset models and algorithm of it to predict the outcome.

This paper [13] has helped to fill the gap between quality, production, and quantity. Data entered by collecting and importing data from multiple real-time applications or cloud storage in the database to ensure fast action. With seamless end-to-end operation and high-end business process, the manufacturer speeds up the process and reaches the supermarkets in a timely manner and makes the proposed system fully operational. In this paper, firstly collect data on the cloud and calculated automatically. The sensors that is used for this purpose like soil moisture, air pressure, rain detection and humidity sensors etc. Wireless data communication: The data is collected from sensors node and forwarded to the server

through wireless transmission. Sensor data attainment: The sensors are boundary with Adriano Uno board such as temperature sensors, Rain detection sensor, humidity and Soil moisture etc. Data analysis & Decision making: The data analysis is the process of analysing the data collected from different sensors from the agriculture field. Automated irrigation system: In the automated irrigation system once, the control established from the mobile application or web application. Mobile Application: The mobile phone application is providing help for monitoring and controlling the agriculture filed from any place. Web application: - The web application will be designed to observe the ground and crops from everywhere using an internet connection. This paper focus on to collect data from various sensors and analyze it to increase crop production where's but in our project, we are trying to utilize IoT devices in more effective ways in respective to cost as well as crop production.

[14] To bring about an increase in yield forecasts, in the current paper we describe a system that includes satellite rainfall and structural data details, periodic weather data from body models and other sources to produce pre-season predictions for grain yield. This program provides very useful results by relaxing the need for more comprehensive data and allowing farmers to prepare for the impact of adverse weather conditions on the crop cycle. In this paper focus on analyzing weather data based on that we are trying to increase crop yield for a particular region. But, in our project we are mostly focus on to increase crop production-based collecting soil data from different parts of country.

[15] This paper has used the ELM algorithm and the KELM algorithm to predict global warming. Different from traditional learning skills, ELM algorithm generously generates input weights and thresholds, and simply sets a number of hidden layer neurons, we can find the right unique solution for the whole world. The algorithm is simple, fast and advanced with precision imitation. In this paper focus on using ELM and KELM algorithm to predict global warming that is different from traditional farming where we are implementing different data of sensors to predict weather.

3 Architectures

A web application developed as the flexibility of API and strongly bootstrapped so that it can be used as the website and android application. The application is being developed using python web development framework "Flask" with the help of HTML & CSS. As the application is powered with machine learning and artificial intelligence algorithms, the python libraries like numpy, pandas, Scipy, Flask-CORS, and a very important library sklearn are used to develop this application.

We collect sets of data of different factors that exhibit a key role in the growth of the crops and process these data to conclude a decision. There are various checks and standard on which our model is trained. Basically, sets of data are kept into csv files from where our model is fetching values and processing it.

Right now, our model is incorporated with decision tree regression algorithm. For each crop our model is analyzing dependencies of the value and concluding through decision tree. For the splitting of the frequencies standard deviation reduction is being used.

Fig. 1 Showing working flow of the application

4 Proposed System

The effect of environmental changes, the harvests that are utilized to be developed by the ranchers procedurally over the entire year has changed. If the system is followed, the yields are insufficient, further placing the ranchers in misfortune. To handle with such issues, we will fabricate an expectation web application, which will propose what to Grow and when to Grow. A significant issue right now Perpetuating in the Indian Market is the worth prediction for assortments of harvests in the market. In the modern days of Science and Technology, it's significant for every one of the various fields to have an advancement with the continuous advances, in later occasions, analysts learning at different schools and colleges commit their lives to imaginative work of developing things and practices. Ranchers have benefitted and added to the reliably creating investigation of cultivating. In this undertaking, we target assisting the rancher with having an exchange advantage at Grain Market utilizing conjecture data. The majority of the occasions, the rancher is dealing with issues of picking the sort of harvest to be filled to have the most elevated benefit. However, the problem can't just be restricted to this as considering a case in some cases regardless of whether the yield developed has a high market interest. Yet, the quality isn't acceptable which further prompts the rancher in the red, so a mix of the two things i.e., picking the best harvest as per the current soil pH, temperature, dampness and precipitation help in choosing the best crop for development. Further, the rancher will likewise approach the anticipated cost for the yield in the coming months, so the rancher can utilize the data, consequently choosing the best harvest to develop. We will give the finished result a Mobile Web App since a portable application is not difficult to work in any event, for an individual with less specialized information on working the Smartphone. The rancher will be given a few devices involving Ph, dampness and so on sensors which will be associated with the Mobile App and the information will be gotten from cloud data set, next we will play out the information cleaning followed by AI strategies, will zero in on the upgrading the Decision Tree Regressor utilizing Scikit apparatuses, Scikit-Optimize library is an open-source Python library that gives an execution of Bayesian Op-

timization that can be utilized to tune the hyperparameters of AI models from the scikit-Learn Python library. We will utilize 80% of information for preparing and staying 20% of information for testing. The prerequisite will utilize different advancements, such as chart.js, NumPy, JavaScript, Bootstrap, and so on. At long last, the outcome will be introduced to the rancher in the GUI Interface.

4.1 Functional Requirements

Product Perspective: Our Product aims to create a simple interface for our beloved country farmers so that they don't have to hesitate any more in deciding which crop to grow on their land, so that it could be optimum in economic way to them.

Product Features: Product calculates different parameters like moisture, temperature, humidity of the land, earlier prices of a particular crop and then gives result whether it is optimum to grow that crop or not for the farmer of a particular region.

User Characteristics: User are mostly related to agriculture Field, Like Farmers, who would use the Product for Getting an idea, of which crop to grow in a particular season.

Assumptions & Dependencies: The IOT devices and the algorithms which we are using, do not show 100% Results, but are made to work Precisely. Therefore, the Final Output of the Product will depend on collecting data for humidity, temperature and Earlier Prices.

Domain Requirements: Arduino System, Web Development (HTML, CSS, JAVASCRIPT), Backend Development (on Flask), Python Programming Language.

User Requirement: The user will require a mobile Device (Android) and Pre-designed IOT device to calculate carryout the forecast estimation on his/her land.

4.2 Non-Functional Requirements

Product Requirement: The product Requires hardware such as Arduino Uno R3, Bread Board, Wi-fi Module etc. and software web apps to provide an easy and minimalistic interface to the user, to carry out the prediction on the userland. The product is designed so that it will take minimal specifications on user device and generate an output using its precise algorithms.

Efficiency: Since Product is linking different modules like web app and Arduino module each other to calculate the prediction, it shows a little delay in fetching the data from the land, but once data is collected, it generates a precise output, with the collected specification.

Reliability: Since it uses a Data tree machine Learning algorithm with accuracy greater than 90%, this product, in most cases, gives reliable answers to its users.

Portability: The product uses a user's mobile device for opening web app and an IOT device to measures different parameters of the land. Therefore, the Overall product is Quite handy.

Usability: The Product is generally made for the agriculture Domain to get the land humidity, temperature, moisture-like data's and pass it through the applied datasets and algorithm to predict the crop to grow.

5 METHODOLOGY

We have developed web app using HTML, CSS, JavaScript, SQL, PHP, etc. then after we have connected the database with cloud database from where sensors reading is stored. Different sensors are used to read soil data like PH level, moisture, light intensity, temperature, precipitation, etc. That data is again processed using predictive model machine learning. This model can predict weather forecast, recommend best crops to grow and predict cost of crops. This work can also be extended into mobile app where all prediction is presented to consumer in simpler and easily interpretable GUI form.

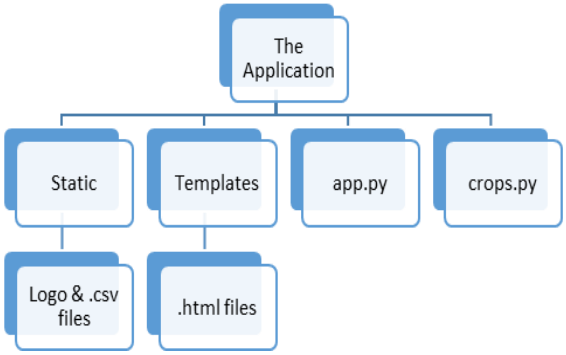

Fig. 2 Structure of Software

Descriptions of module and functions:

- app.py
  This is the file in which all the functions are defined and declared the framework. Different
  - getPredictedValue(self, value)
    This function gives the predicted value of the crop.
  - index()
    This function renders the html page basically, it gives renders home page.
  - TopFiveWinners()
    This function gives the top five winner crops.
  - TopFiveLosers()
    This function gives the top five looser crops.
  - SixMonthsForecast()
    This function forecasts the values for the next six months.
  - SixMonthsForecastHelper(name)
    This function helps with forecasts for the next six months.
  - TwelveMonthsForecast(name)
    This function forecasts the values for the next twelve months.
  - TwelveMonthPrevious(name)
    This function forecasts the values for the next twelve months.
- crops.py
  This file carries the dictionary of the crops.

7 E

The starting page of the web app contains 2 different sections namely TopGainer Sections (Current trends) and TopLoser (Current trends).

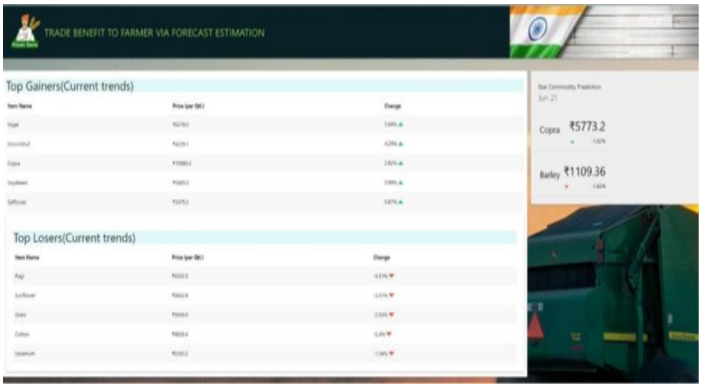

Fig. 3 Homepage of web app

a) Top Gainers section shows the top data of top 5 crops that can show possibly good results for a particular land using datasets of humidity, temperatures, prices of previous years, moisture. The list shows the item name, price (per quintal) and change percentage of the crop.

b) Similarly, the section below the Top Gainers section contains the "The Top Losers Section", which shows the 5 crops list that is about to show poor yield results on the applied datasets.

Apart from these two sections on Right side of the web app we have provided a section/ separate window which shows the percentage change of both top gainer and top loser crop on a range from January to December.

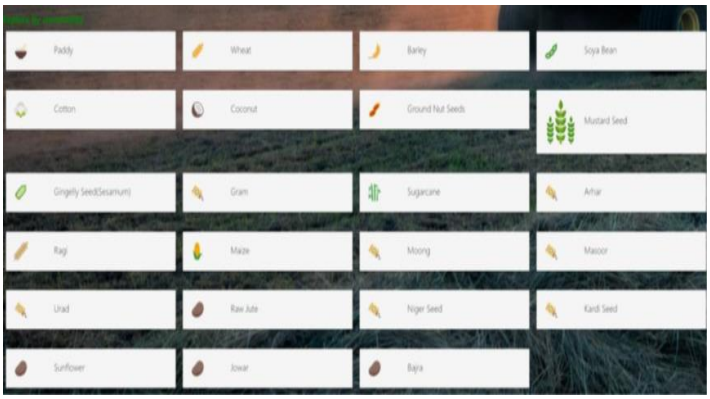

Fig. 4 Showing crops list

In Explore by commodity section, we have provided a single window system to navigate inside any desired crop section to view its full statistics like current price, prime location, crop type, exporting countries etc.

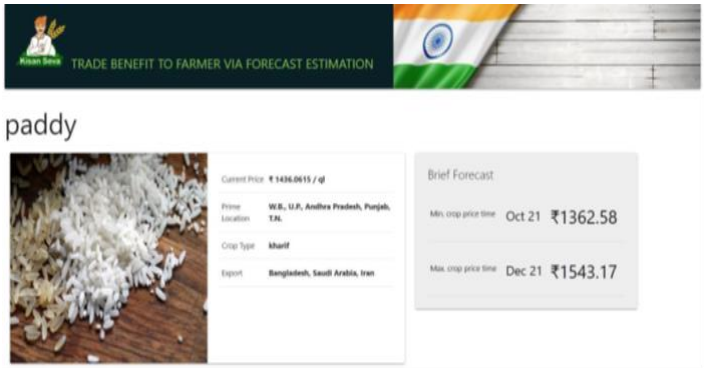

Fig. 5 Commodity Section

Under commodity section of any crop chosen, different details will be provided like current price, prime location, crop type and right-side section show the minimum and maximum crop price time including their month and price.

Fig. 6 Graphical & tabular representation of price vs year

This section also contains a list of price change list where all the price change percentage is listed according to the months in a year. Apart from all these the page shows the Graphs related to the previous year and calculated upcoming year price of a particular chosen crop.

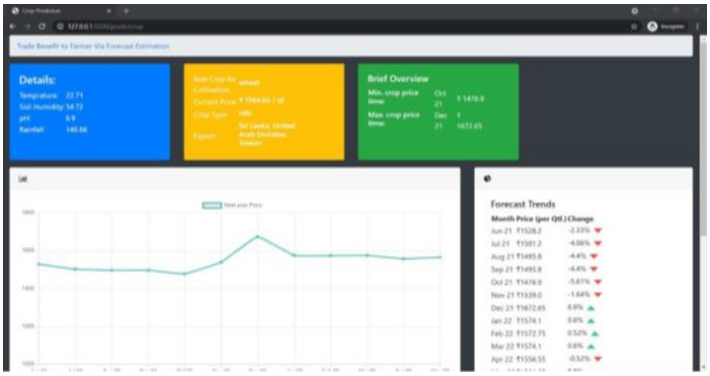

Fig. 7 Crops prediction based on environmental condition

Fig. 8 Graphical & tabular form in prediction page

This module basically focuses on the crop prediction of the best crop to be grown, as we can see in the blue box, we are having values for different parameters of the farmer farm i.e., Temperature, Soil Humidity, Ph and rainfall, all the above values are fetched from the Arduino module as discussed. In the next box mentioned i.e., yellow box we have the best crop prediction for the suited environmental conditions, as we can see from the above observation, we have wheat as the best suited crop for the above conditions mentioned. Also, the data also infers about the crop type and export to different coun-

tries. Coming to the next box gives information to the brief overview guiding to the minimum crop price and maximum crop price with the respective months of the year, so it becomes easy for the farmer when he/she should see the crops. All the above implementations are done via Machine Learning Algorithm i.e., Decision Tree with more than 80% accuracy. Coming to the next phase of the implementation we have implemented two graphs placed side by side guiding about the future forecast of the crop predicted with each and every month, so the farmer can get an idea for the hype or lower of the crop price, the same is compared with the graph as shown to the below of this for the previous year statistics. Next implementation to this module is average variation change to the crops every month, the same is shown in the forecast trends card, showing what variation in price is there for the particular crop, red color alerts for the price gone down and green color denotes the increase in the price of the commodity predicted. So above implementation helps the farmer to get the best predicted crop along with the prices of the commodity for the upcoming months will certainly help the farmers to reduce debts and start farming.

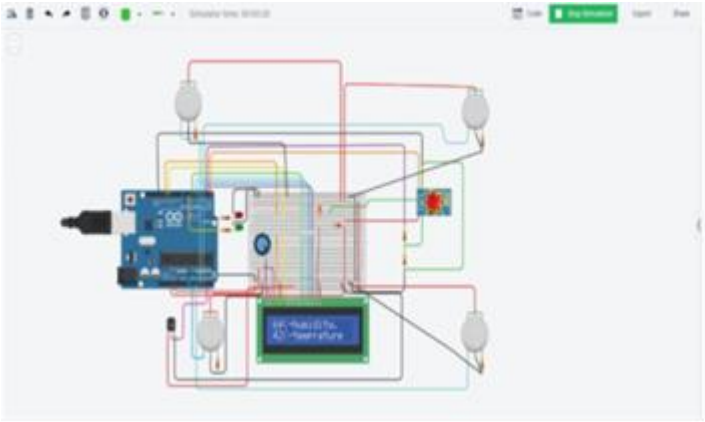

Fig. 9 Arduino circuit

4 Conclusion

A web app integrated with machine learning predictive model is developed which has accuracy of 80%. This project seems very helpful for farmer to solve the major problem of value prediction, best crop recommendation and weather forecast. Farmer has to operate some sensors and accordingly, the model will show best crops to grow. It enhances a smart way of agriculture in India and thereby it helps nation to overcome poverty and increase economy of country.

5 Acknowledgment

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