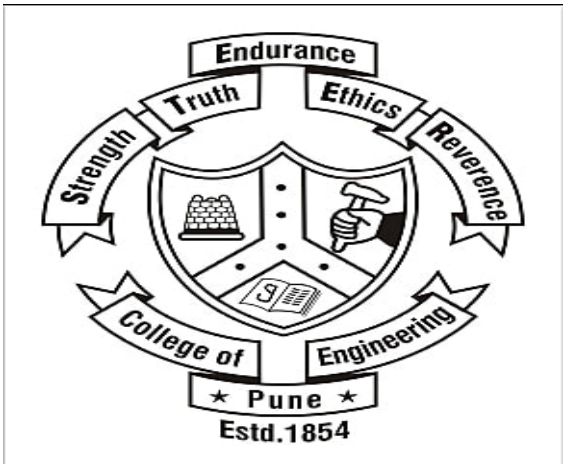
AI-Assisted Farming for Crop Recommendation & Farm Yield Prediction Application

SUBMITTED BY:

Team Gravitas

Mr. NEEL VITTHAL SONAWANE

Ms. PRAJAKTA PRAVIN PATIL



COLLEGE OF ENGINEERING PUNE

(An Autonomous Institute of Govt. of Maharashtra)

DEPARTMENT OF MANUFACTURING ENGINEERING AND INDUSTRIAL MANAGEMENT

M.Tech. (Artificial Intelligence & Robotics)

(2020-21)

1. Introduction

1.1 Overview

Agriculture is practiced across India as an occupation and is a source of livelihood for 58% of the population of India. This is a huge figure. But many farmers in India are considered poor as agriculture is not being a profitable field for many. The reasons for this are various but mostly it is because of practicing traditional methods of agriculture. Most of them depend on the traditional seasonal farming that is continued over the years to grow crops. But now the times have changed the cycle of traditional seasons is changing because of climate change and global warming. Unpredicted rainfall, excess or lack of heat, excess or lack of cold are a few parameters that are destroying the crops. Basically, wrong choice of crops at unsuited times with unsuited conditions ruins the entire yield. Thus, causing huge loses. Some farmers also commit suicides in India because of losses incurred. AI assisted farming for crop recommendation and yield prediction will assist farmers in recommending to take a particular crop based on various parameters like current climate, soil conditions, rainfall etc. It will predict the approximate yield of that crop and also the approximate revenue.

1.2 Purpose

There are many problems currently associated with the agriculture sector. The demand for produce is only going up every day as the population increases. The crop production should also increase with the same rate. However, because of the unpredictable nature of the atmosphere the crop growth and produce gets hampered. Unwanted rain washes away the crops hence loss of produce. Even excessive heat damages the crops. All of this could be changed to an extent if we have the predicted nature of the atmosphere over a certain time period. Considering these predicted values of the atmosphere like temperature, rainfall, humidity, etc mapping it with the atmospheric conditions required by a crop, we can find out which crop will be the best suitable to be grown in that particular region where the farmer lives in. Even the soil parameters are equally important for the growth of any plant. If we know the current soil conditions, we can map it with the soil conditions required for a certain crop and find out which crop is the best suited for the farmer. Such cases are an example of how we can benefit the farmer by trying our best to make use of Artificial Intelligence to recommend crops which will be profitable to the farmers. Such systems will help to pre-empt the weather and soil conditions that will recommend a crop that will not cause any loses to the farmers even in adverse weather conditions. This will also indirectly reduce farmer suicides as life is very precious. Hence such systems have a huge purpose to be played in the agricultural industry.

2. Literature survey

2.1 Existing problem

1. RakeshKumar , M.P.Singh, Prabhat Kumar and J. P.Singh ,”Crop Selection Method to Maximize Crop Yield Rate using Machine Learning Technique,2015, In this , the authors have discussed different parameters which influence the crop classification methods. The proposed Crop Selection Method classifies crops as seasonal crops, whole year crops, short time plantation crops, long time plantation crops.

2. Ayush Shah, Akash Dubey, Vishesh Hemnani, Divye Gala and D. R. Kalbande,” Smart

Farming System: Crop Yield Prediction Using Regression Techniques, In this, the authors have suggested a smart way to forecast the crop yield and also suggested the ideal climatic factors to maximize the crop yield. The suggested method uses yield and weather data. The authors have used Mean Absolute Error (MAE), Root MeanSquared Error (RMSE), median absolute error and R-Square values to compare between multivariate polynomial regression, support vector machine regression and random forest.

3. 2017 International Conference on I2C2, “Agriculture decision support system using data mining”, the authors have proposed a system which helps the users to make decisions regarding the crop to be planted. The system used is a subscription-based system which would have personalized information of every farmer registered. The system includes a module which maintains the information of the previous crops planted collected from various sources and shows a matching crop that can be planted.

2.2 Proposed solution

After brainstorming a lot on how to deal with the problem at hand we decided to follow certain steps. We defined the scope of the project to the state of Maharashtra and the various districts in it. We then tackled the root cause of the problem statement. We found out that the atmospheric parameters and the soil conditions are the main factors behind the growth of any crop. That was the beginning of our steps. We determined the various atmospheric conditions required for the main 15 different crops grown around Maharashtra. We found out the favourable conditions viz. rainfall, temperature, humidity and wind speed for these 15 crops. A dataset of the same was created which had all these values and the weather API key was given to the model which gave real time district-wise weather conditions. The farmer just has to mention his district and all the weather parameters are automatically fetched.

Next, we found out the favourable soil conditions required for each of these crops. Various conditions like the nitrogen(N), phosphorous(P), and potassium(K) and were determined for each crop. Even the favourable pH levels were obtained. The dataset was formed. The model was trained on this dataset. However, the farmer will have to test the soil in his farm and put the values of NPK and pH as input to the model.

Based on the atmospheric conditions and the quality of the available soil, the model will recommend the most suitable crop to farmer.

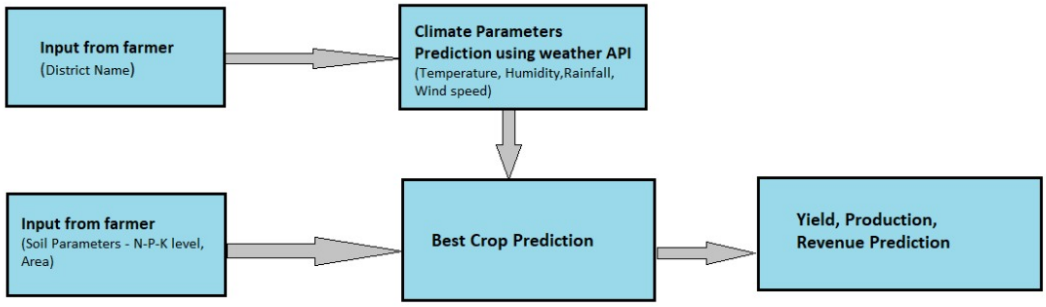
To find the yield and the revenue, we found out the historical data of these crop of 5 years to train the model. This dataset had the fields of area of field, production and yield. Based on the recommended crop the model found out the yield of the that crop. We took the area of the farm as the input from the farmer. Multiplying the predicted yield and the farm are gave us the production.

Multiplying the MSP value of the crop with the production value gave us the revenue of the crop.

3. Theoretical Analysis

3.1 Block diagram

Below is the block diagram for the project.



3.2 Hardware / software designing

We have used the IBM services to find the recommended crop. Following are the services offered by IBM for working into AI domain.

Cloud Foundry apps (1)					
Node RED JOPBK 2021-07-04	patilpp20.mfg@coep.ac.in / dev	London	Started	–	
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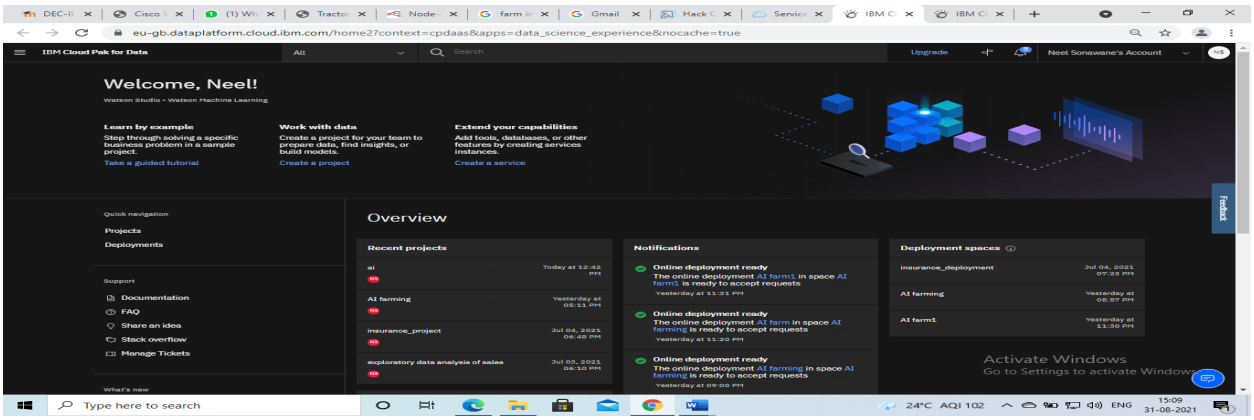
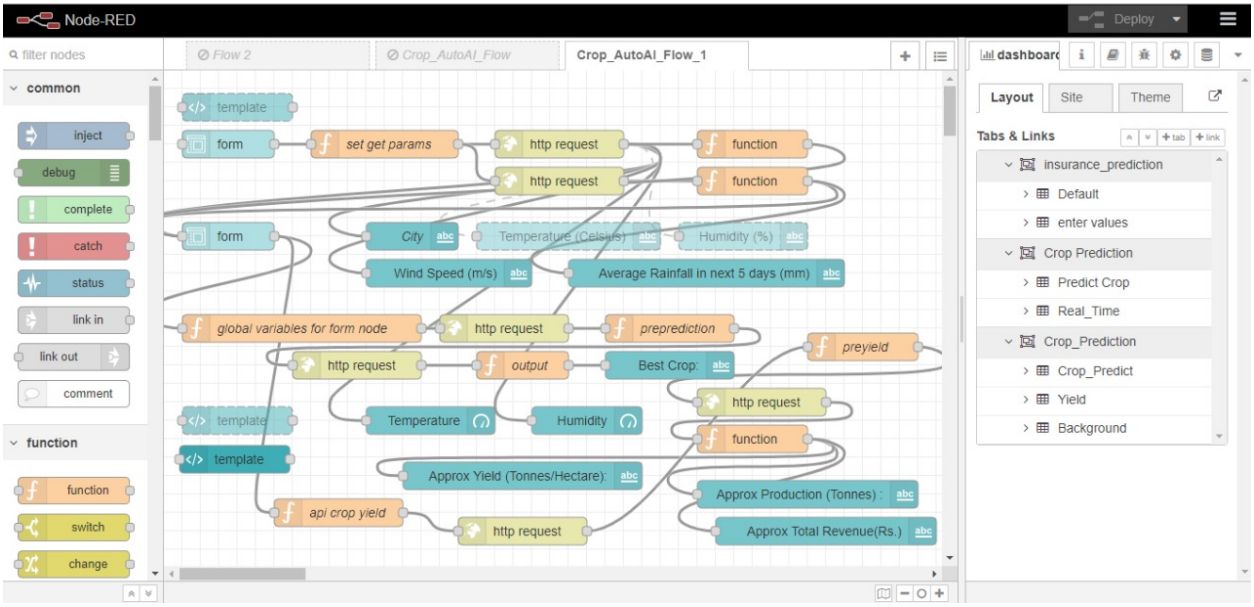
node-red-jopbk-2021--cloudant-1625407...	patilpp20.mfg@coep.ac.in / dev	London	Provisioned	–	
Services and software (5)					
Continuous Delivery	Default	London	Active	–	
Machine Learning-hm	Default	London	Active	cpdaas	
Watson Assistant-6q	Default	Washington DC	Active	–	
Watson Studio-df	Default	London	Active	–	
node-red-jopbk-2021--cloudant-1625407...	Default	London	Active	–	
Storage (1)					
Cloud Object Storage-cd	Default	Global	Active	cpdaas	

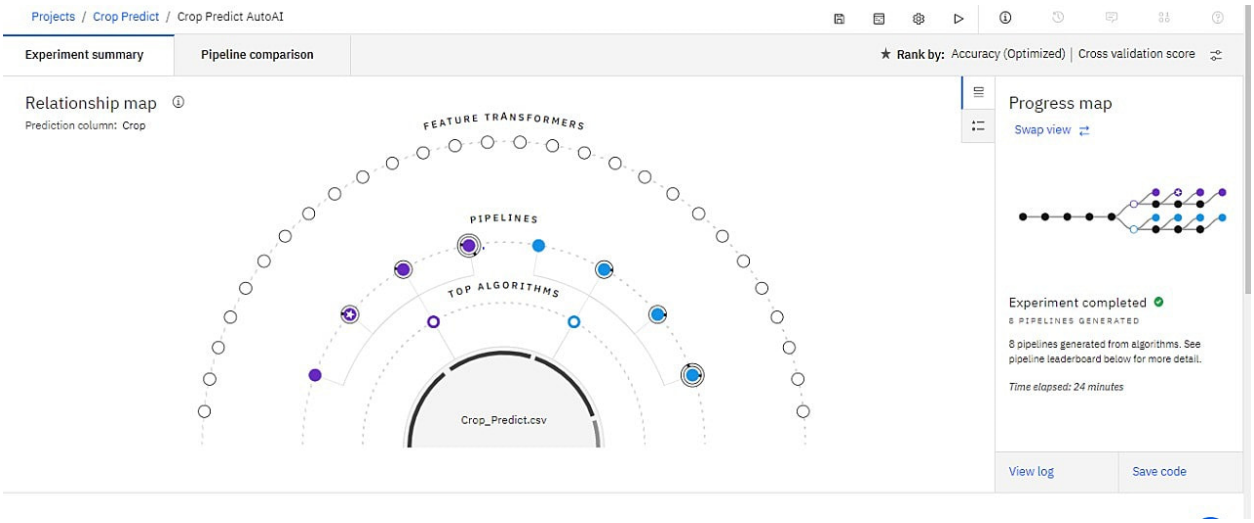
We began with Watson studio. It is a powerful tool to predict future outcomes. It also automates complex processes. Below is the GUI of IBM Watson

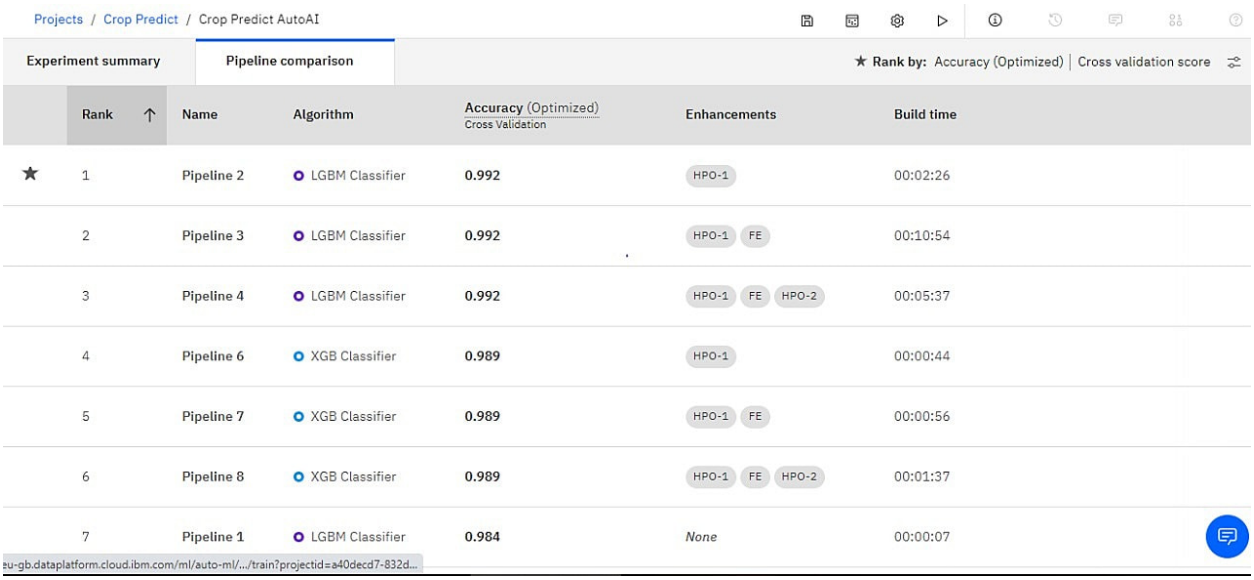


Node-Red is a platform that allows you to create functionality by wiring together flows of data between nodes using a browser.It uses flow-based programming to let you draw a visual representation of how messages should flow through the application. Below is the flow built in Node-Red for the project.



The IBM AutoAI graphical tool in Watson Studio automatically analyses your data and generates candidate model pipelines customized for your predictive modeling problem. These model pipelines are created iteratively as AutoAI analyses your dataset and discovers data transformations, algorithms, and parameter settings that work best for your problem setting. Results are displayed on a leaderboard, showing the automatically generated model pipelines ranked according to your problem optimization objective. Shown below is the use of AutoAI done in the project.

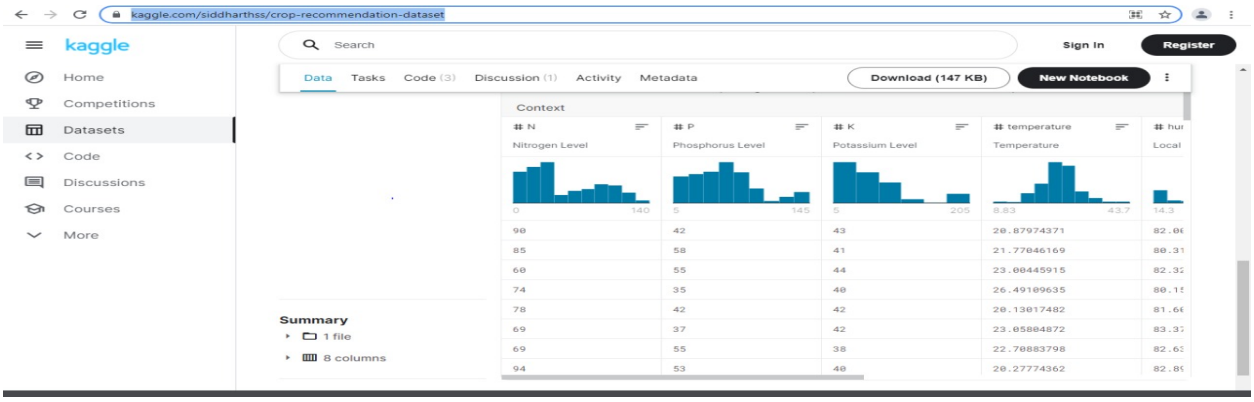




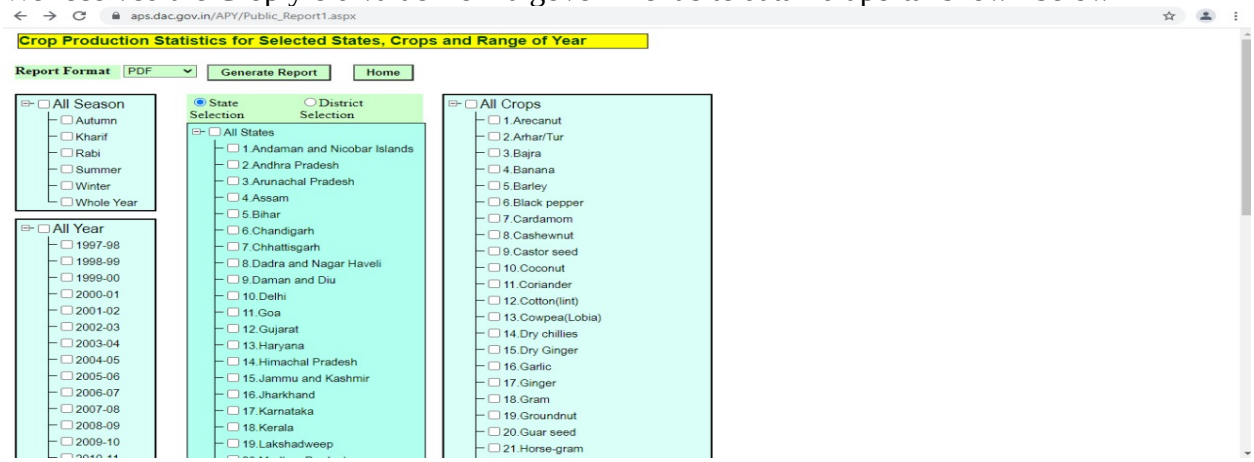
	Rank	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1	Pipeline 2	LGBM Classifier	0.992	HPO-1	00:02:26
	2	Pipeline 3	LGBM Classifier	0.992	HPO-1 FE	00:10:54
	3	Pipeline 4	LGBM Classifier	0.992	HPO-1 FE HPO-2	00:05:37
	4	Pipeline 6	XGB Classifier	0.989	HPO-1	00:00:44
	5	Pipeline 7	XGB Classifier	0.989	HPO-1 FE	00:00:56
	6	Pipeline 8	XGB Classifier	0.989	HPO-1 FE HPO-2	00:01:37
	7	Pipeline 1	LGBM Classifier	0.984	None	00:00:07

4. Experimental investigation

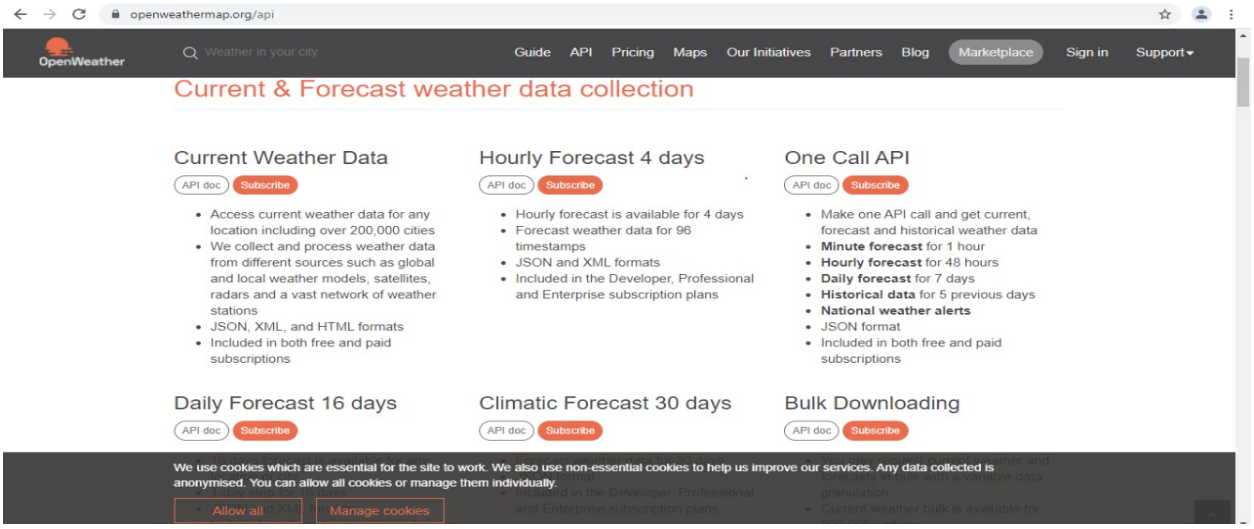
For collecting dataset, we searched for various government sites. We found data for crop's N,P,K levels shown below



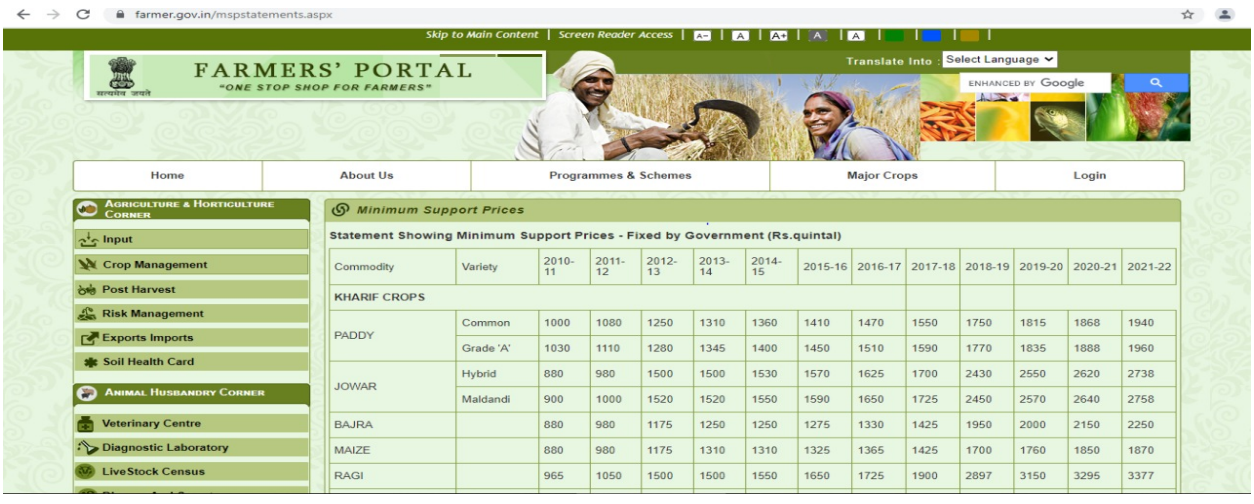
We received the Crop yield value from a government site dataindiaportal shown below



We received the weather data from the openweather API



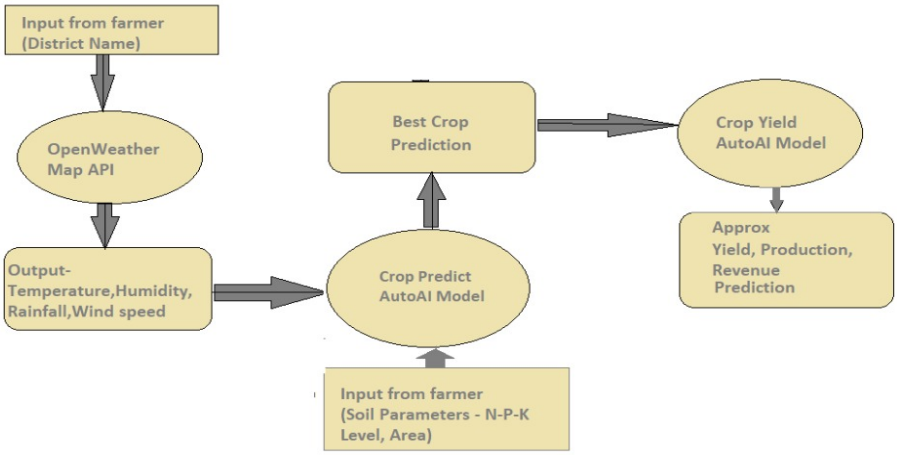
The MSP values of the crops has been received from ‘farmers’ portal’ shown below



Due to unavailability of data, we limited our scope to only Maharashtra state. We have selected the top 15 main crops that are grown in Maharashtra.

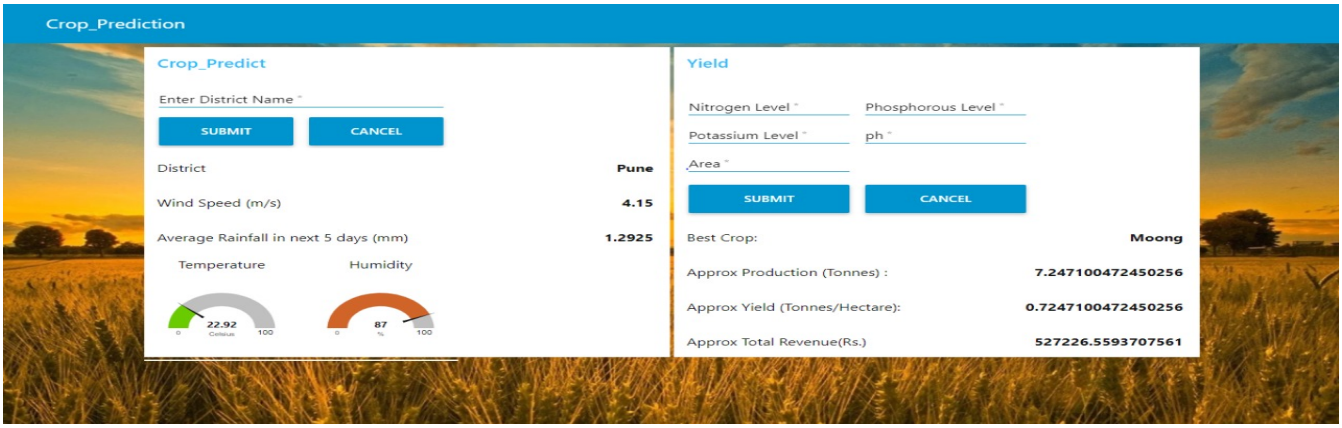
5. Flowchart

Shown below is the flowchart of the project.



6. Result

The AI-assisted crop recommendation system and yield prediction system considers various parameters related to the atmosphere and soil conditions to give a recommendation of the best crop for the farmer. The farmer inputs the soil condition parameters viz. N,P,K and pH levels. He also enters the area of his farm which calculates the yield and revenue. The dataset has been carefully crafted to choose the best suited crop for the region of Maharashtra. It is one of the biggest boons to the farmer. The use of IBM Watson, AutoAI and node-red made our complex job very easy viz. training the model, etc. Node-Red has easily created a GUI that is user-friendly. Below is the image of the final GUI of the project. All input parameters can be easily seen. The model not only predicts the yield but gives the revenue of the crop based on the current MSP prices of that particular crop.



7. Advantages and Disadvantages

Advantages of this system are many. Major advantage is that it recommends crops suitable to the conditions hence avoiding damage of crops that would have otherwise being planted. It uses 2 models to predict crop and the yield. It recommends crops based on real-time weather conditions. It also considers the soil conditions for the recommending the crop. It also predicts the yield, production and even the revenue.

Disadvantage is that the scope is limited to the region of Maharashtra and only to the main crops. Farmers have to do soil testing every time before taking up a new crop. The weather data is limited only to a few days.

8. Applications

The system had wide range application in the agricultural sector to increase the production by recommending proper crops for particular region.

9. Conclusion

The AI-assisted crop recommendation system and yield prediction application is able to successfully predict the crop based on the atmospheric parameters and soil conditions given after soil testing by the farmer. At any given time one crop is more suited to be grown than other based on the above conditions. The two models of crop and yield are successfully trained in AutoAI which then predict appropriate crop and yield respectively.

10. Future scope

One big future scope is actually increasing the scope of the project. Currently it is restricted to just Maharashtra. It could be expanded to entire India. We can also include more crops. Fruits can also be included in the system. Furthermore, we can also add parameters where the system can recommend fertilizers for a crop based on current soil conditions. Crops based on particular land type and based on availability of water could be another feature than can be added.

11. Bibliography

https://indiadataportal.com/datasets-page?view-dataset=food-and-agriculture-tab&language=&location=India

https://www.india.gov.in/topics/agriculture/crops

https://seednet.gov.in/SeedPlan/2013-2014/seedplan.html

https://farmer.gov.in/StateAgriDepartments.aspx

https://www.kaggle.com/siddharthss/crop-recommendation-dataset

https://aps.dac.gov.in/APY/Public_Report1.aspx

https://farmer.gov.in/mspstatements.aspx

Appendix

Source code –
https://node-red-jopbk-2021-07-04.eu-gb.mybluemix.net/ui/#!/0?socketid=aGezF1klxamhutkGAACW

Code excerpt-

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/predictions?version=2021-08-31","tls":"","persist":false,"proxy":"","authType":"","x":650,"y":360,"wires":[["54715f50.a2ec1"]]},{"id":"54715f50.a2ec1","type":"function","z":"17327935.be85b7","name":"","func":"msg.payload = msg.payload.predictions[0].values[0][0]\n\nmsg.prod = msg.payload * global.get(\"area\")\n\nvar qui = msg.prod * 10\n\nvar crop = global.get(\"crop\")\n\nvar rev = 0\n\nif(crop==\"Rice\")\n{\n rev = 1940 * qui\n}\n\nelse if(crop==\"Bajra\")\n{\n rev = 2250 * qui\n}\nelse if(crop==\"Banana\")\n{\n rev = 1000 * qui\n}\nelse if(crop==\"Cotton\")\n{\n rev = 5726 * qui\n}\nelse if(crop==\"Groundnut\")\n{\n rev = 5550 * qui\n}\nelse if(crop==\"Maize\")\n{\n rev = 1870 * qui\n}\nelse if(crop==\"Moong\")\n{\n rev = 7275 * qui\n}\nelse if(crop==\"Sugarcane\")\n{\n rev = 300 * qui\n}\nelse if(crop==\"Tur\")\n{\n rev = 6300 * qui\n}\nelse if(crop==\"Ragi\")\n{\n rev = 3377 * qui\n}\nelse if(crop==\"Jowar\")\n{\n rev = 2738 * qui\n}\nelse if(crop==\"Onion\")\n{\n rev = 1500 * qui\n}\nelse if(crop==\"Soyabean\")\n{\n rev = 2500 * qui\n}\nelse if(crop==\"Sunflower\")\n{\n rev = 6015 * qui\n}\nelse if(crop==\"Wheat\")\n{\n rev = 1975 * qui\n}\n\nmsg.rev = rev\n\n\nreturn msg;","outputs":1,"noerr":0,"initialize":"","finalize":"","libs":[],"x":640,"y":400,"wires":[["a7f07cea.2141","d282afd0.cf789","1bd21d4f.8aaf43"]]},{"id":"d282afd0.cf789","type":"ui_text","z":"17327935.be85b7","group":"89493a0a.194cc8","order":4,"width":0,"height":0,"name":"","label":"Approx Yield (Tonnes/Hectare):","format":"{{msg.payload}}","layout":"row-spread","x":390,"y":440,"wires":[]},{"id":"1bd21d4f.8aaf43","type":"ui_text","z":"17327935.be85b7","group":"89493a0a.194cc8","order":5,"width":0,"height":0,"name":"","label":"Approx Total Revenue(Rs.)","format":"{{msg.rev}}","layout":"row-spread","x":720,"y":500,"wires":[]},{"id":"9f483759.ef58a8","type":"function","z":"17327935.be85b7","name":"","func":"global.set(\"temp\",msg.payload.main.temp)\nglobal.set(\"hum\",msg.payload.main.humidity)\n\nreturn msg;","outputs":1,"noerr":0,"initialize":"","finalize":"","libs":[],"x":640,"y":80,"wires":[["a64250a7.ab228"]]},{"id":"28eb8036.e2b0d","type":"function","z":"17327935.be85b7","name":"api crop yield","func":"\nvar apikey = \"zjdxOLpajlago2_oOO-H1EoJ3j86EOfHIz1-fP6fWN_O\"\nmsg.headers={\"content-type\":\"application/x-www-form-urlencoded\"}\nmsg.payload={\"grant_type\":\"urn:ibm:params:oauth:grant-type:apikey\",\"apikey\":apikey}\nreturn msg;","outputs":1,"noerr":0,"initialize":"","finalize":"","libs":[],"x":190,"y":480,"wires":[["ff7e27dc.b31888"]]},{"id":"ff7e27dc.b31888","type":"http request","z":"17327935.be85b7","name":"","method":"POST","ret":"obj","paytoqs":"ignore","url":"https://iam.cloud.ibm.com/identity/token","tls":"","persist":false,"proxy":"","authType":"","x":390,"y":500,"wires":[["2246e7ee.270a78"]]},{"id":"cc4ea34d.b5da9","type":"ui_template","z":"17327935.be85b7","group":"4e1924f6.27e3ec","name":"","order":6,"width":"0","height":"0","format":"<style>\n body {\n background-image: url(\"https://wallpaperaccess.com/full/488907.jpg\");\n background-repeat: no-repeat;\n background-position: right top;\n background-size: 100%;\n }\n</style>","storeOutMessages":true,"fwdInMessages":true,"resendOnRefresh":true,"templateS

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