HACK CHALLENGE 2021

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

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Project Id: SPS_PRO_2095
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1. INTRODUCTION

1.1: Overview - A brief description about your project

Farmers being the backbone of our economy, makes it imperative for society to invest into the efficacy of farming. One obvious way to go about it is to improve agricultural yield. Now, the success of the crop depends on many interrelated factors, which can be broadly categorized into environmental and financial. Our solution uses **Machine Learning models** to predict the best crop production possible, given **the environmental and economical factors**. It also predicts the yield of the crop based on historical data. In this way, we can help the farmers to make an optimized choice and increase the profitability of the profession and in turn add value to the economic growth.

1.2: Purpose -The use of this project. What can be achieved using this.

The solution can be progressively developed as a game changer for India. Indeed, crop production and profitability is a complex affair involving many disciplines of pure science and economics, which makes it highly suitable for ML approach. The business impact of the solution is potentially infinite. It has the potential to revolutionize the Indian economy, and can also foster sustainable use of the environment. It will release the Indian farmers from the bondage of perennial poverty and will also provide ample revenue to the service providers.

2: LITERATURE SURVEY

2.1: Existing problem: Existing approaches or method to solve this problem

When the weather strikes or diseases are rife, farmers suffer from lower crop yields. Simultaneously, the global population is growing and urbanization is continuing. Disposable income is rising, and consumption habits are changing. Farmers are under a lot of pressure to meet the increasing demand, while at the same time farm area is shrinking, also due to environmental concerns. This justifies the need to increase productivity at an ever increasing rate. Thirty years from now, there will be more to feed, and since the amount of fertile soil is limited, there will also be a need to move beyond

traditional farming.

The traditional approach has been to develop complex mathematical models to which tries to predict the best crop, based on several factors and use simple statistical tools to interpolate the historical yield data to predict future yield. However such classical approaches are inadequate to solve the problem. So ML based approach has been applied hence. The paper **"Crop yield prediction using machine learning: A systematic literature review"** by Thomas van Klompenburg, Ayalew Kassahun, and Cagatay Catal, published in the prestigous journal **"Computers and Electronics in Agriculture"** last August has been the primary source of our literature review. This paper neatly summarizes the historical and current evelopments in the field of ML in crop and yield prediction. Based on the collective knowledge gained from the research conducted before, we have implemented our algorithms.

2.2 - Proposed solution What is the method or solution suggested by you?

For crop prediction, it takes as input six parameters:

- Amount of Nitrogen in soil
- Amount of Phosphorus in soil
- Amount of Potassium in soil
- Mean Temperature in Celsius
- Mean Humidity
- Mean pH value of Soil
- Seasonal rainfall in milimetre

It then fits them in a Machine Learning Model and gives, as an output, the best crop to be grown.

For yield prediction, it takes as input four parameters:

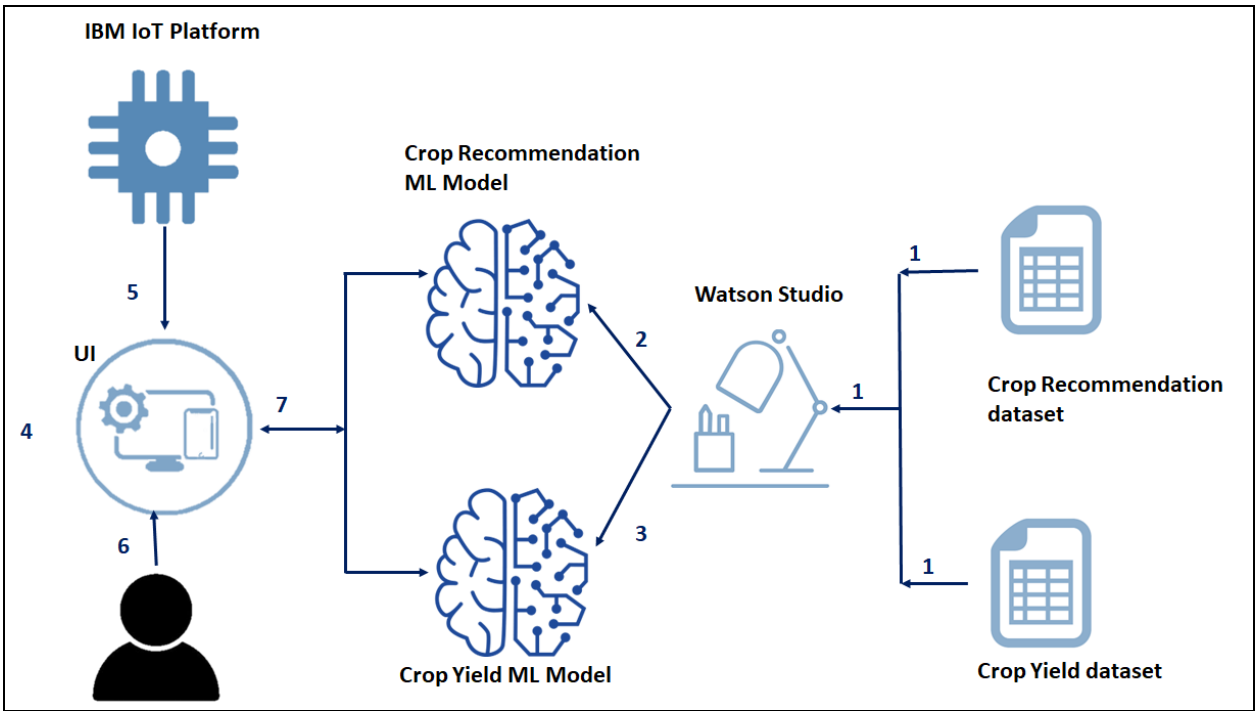
- Season in which the crop shall be grown
- The name of the crop
- The name of the district
- Number of years passed since 2010

It then fits them in a Machine Learning Model and gives, as an output, the expected yield of the crop.

We have also implemented a solution where IoT based sensors can directly read the values from Nature and feed it to our model, thus relieving the farmers from this duty.

3: THEORETICAL ANALYSIS

3.1 - Block diagram: Diagrammatic overview of the project.



3.2 - Hardware / Software designing: Hardware and software requirements of the project

The Software requirements are:

- IBM Watson Studio: To build the ML Model
- IBM IoT Platform: To connect the IoT sensors
- Node Red Platform: To build User Interface
- Crop Recommendation dataset: We used https://www.kaggle.com/siddharthss/crop-recommendation-dataset
- Crop Yield dataset: We collected the data from the website https://www.aps.dac.gov.in

The Hardware requirements are:

- IBM Cloud
- IoT Sensors
- A simple PC or smartphone to access the interface.

4: EXPERIMENTAL INVESTIGATIONS

4.1 - Analysis or the investigation made while working on the solution.

We had to do some research work in order to find out the appropriate features for our task. Finding out the dataset, itself was a herculean task, and in addition to that we also had to do some digging in order to find out the appropriate units for our data. For all of these we referred to a couple of government websites and also went through some of the available blogs and reports.

Finally a lot of thought also went into the designing of the UI. Essentially, we had to keep in mind that the users would mainly be the farmers who aren't tech savy, so the entire process had to be as simple and intuitive as possible.

5: FLOWCHART

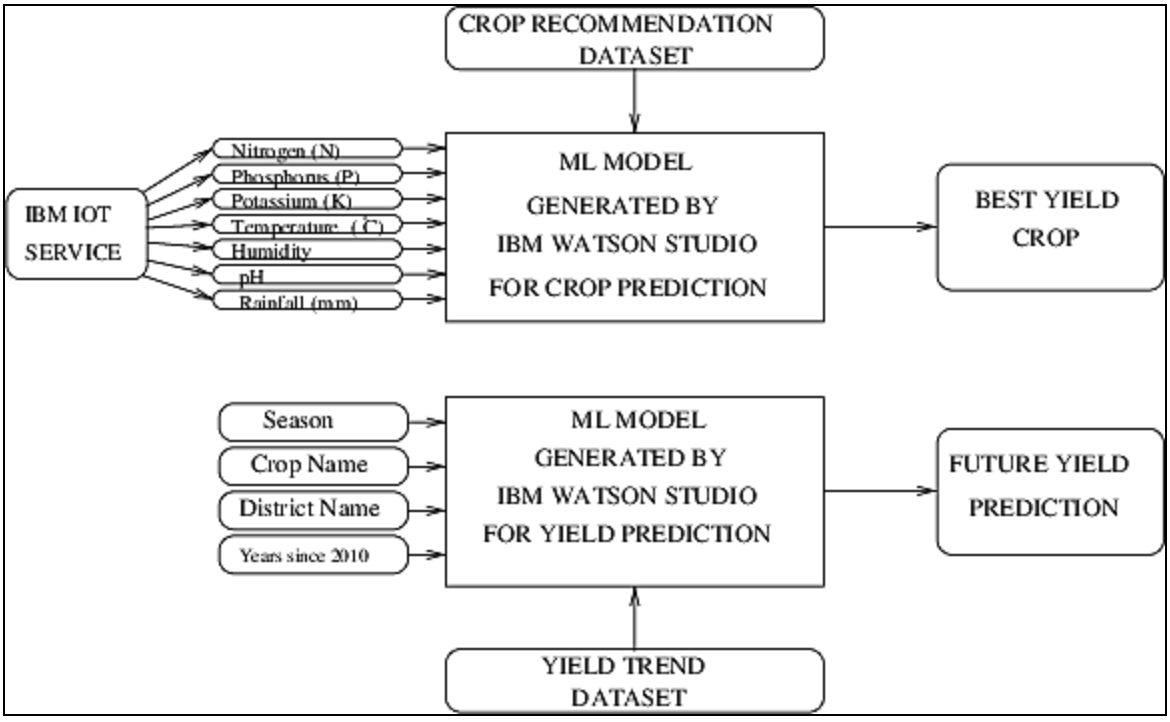
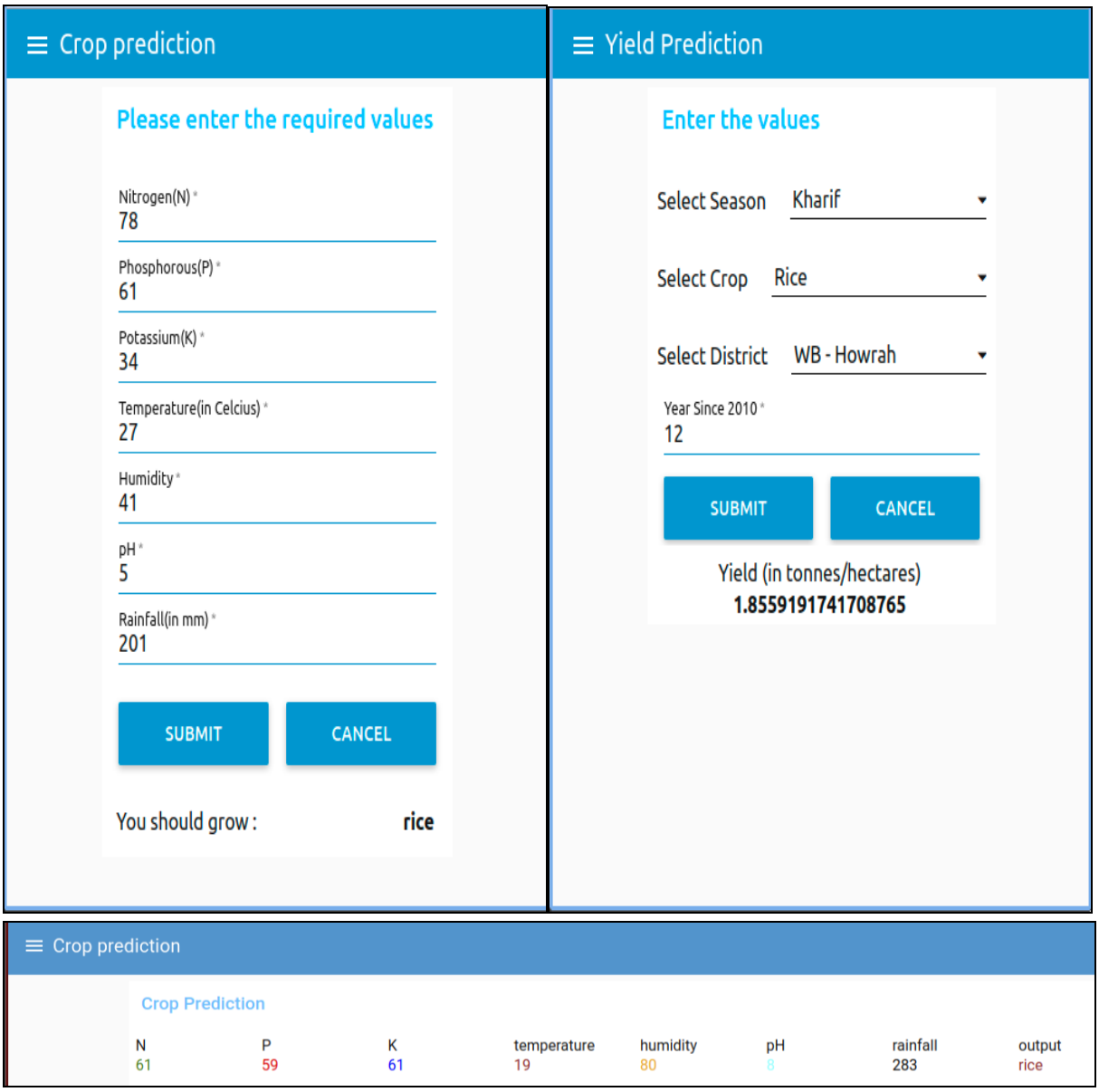


Diagram showing the control flow of the solution

6: RESULT



Final findings (Output) of the project along with screenshots.

7: ADVANTAGES & DISADVANTAGES

7.1 - List of advantages and disadvantages of the proposed solution

Advantages:

- Our solution aims at helping the farmers who form the backbone of our economy.
- Relevant Data has been used, which gives us an edge
- Optimized Machine Learning models trained on historical data has been used for prediction which makes our solution desirable
- The UI has been made extremely straight forward and easy to use, catering to the needs of the farmers.
- Finally everthing is hosted by IBM servers which makes our solution extremely reliable and one of a kind.

Disadvantages:

- Our solution hasn't been tested with real IoT based devices, so there we might face some problems related to the transfer of corrupted data.
- We don't have the appropriate domain knowledge to make our Machine Learning models interpretable.

8: APPLICATIONS

8.1 - The areas where this solution can be applied

- Our primary area of application is the agricultural sector, the backbone of the country. The solution is equally effective for both cash and subsistence crops.
- With minimal change, the domain can be expanded to agro-forestry and horticulture too.
- Again, the solution can also be extended in principle to animal husbandry, pisciculture, beekeeping and other related fields too.
- The academia can also derive useful insights from our model.
- Fertilizer and seed industry can study our predictions and anticipate their demand.

9 CONCLUSION

9.1 - Conclusion summarizing the entire work and findings.

Our solution does a pretty good job in predicting the best crop production possible, given the environmental and economical factors. It also predicts the yield of the crop based on historical data quite accurately. In this way, we can help the farmers to make an optimized choice and increase the profitability of the profession. Therefore, this will act as real game changer and will also give a big economic boost to the entire country.

10: FUTURE SCOPE

10.1 - Enhancements that can be made in the future.

- Save the query of the farmer into training data, should he be satisfied and is willing to do so.
- Augment more knowledge from domain experts and use them to improve the quality of prediction.
- Use GPS to automatically detect the position of farmer to determine the district. Prefill the 'years since 2010' field.
- Expand the scope of number of crops predicted.
- Predict the amount of fertilizer required to provide optimal output
- With input from governmental sites, show the minimum support price and the estimated revenue.
- Extend our work to the field of agro-forestry, horticulture, animal husbandry and pisciculture.
- With the help of IoT sensor and GPS services implement the whole interface in the form of SMS service so that even the poorest of the farmer can afford to use it.

11: BIBILOGRAPHY

11.1 - References of previous works or websites visited/books referred for analysis about the project, solution previous findings etc.

1. The webpage 'https://smartinternz.com/hack-challenge-2021'
2. Thomas van Klompenburg , Ayalew Kassahun , Cagatay Catal (2020), 'Crop yield prediction using machine learning: A systematic literature review', Computers and Electronics in Agriculture Journal.
3. S.Pudumalar, E.Ramanujam, R.Harine Rajashreen, C.Kavyan, T.Kiruthikan, J.Nishan (2016), 'Crop Recommendation System for Precision Agriculture', 2016 IEEE Eighth International Conference on Advanced Computing (ICoAC).
4. 'Agriculture Statistics at a Glance 2017' by Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics & Statistics
5. 'Agriculture Research Databook 2019' by Indian Council of Agricultural Research
6. 'FarmEasy: Crop Recommendation for Farmers made easy', a blog by Darshan Gandhi at the website 'Towards Data Science'.
7. 'Indian Crop Production: Exploratory Data Analysis to chart Agriculture highlights

using Python', a blog by Dr. C. S. Jyothirmayee at the website 'Medium.com'
8. The website 'https://krishi.icar.gov.in'

APPENDIX

A. Source Code

- **Notebook For Crop Prediction**
- **Notebook For Yield Prediction**
- **Node-Red flow For Crop Prediction using form**
- **Node-Red flow For Crop Prediction using IBM IoT Service**
- **Node-Red flow for Yield Prediction**