Annadata

MBA Tech. Computer Engineering
Final Project Presentation

अन्नदाता(A Krishak Kalyan App)

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ROADMAP

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- Introduction
- Problem Statement
- Motivation
- Scope of the Project
- Literature Review
- Analysis and Design
- Implementation
- Deployment
- Future Work
- Impact
- References

INTRODUCTION

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- There are many problems that a farmer faces during their day-to-day life. They are not well educated and generally people like merchants take advantage of farmers and they often mislead them, for example, charging more money from the farmer than the actual rate, and there are many such examples which suggest that the farmer in our country are taken advantage of.
- They may not have proper knowledge of how market works or what seeds to sow at what time of the year.
- Keeping the above points in mind we have decided to help our farmers, by developing an app **Annadata: A Krishak Kalyaan App**
- It has been developed using latest technologies like ML and Data Analytics.
- It has an integrated platform which will cover up solutions for most of the problems faced by farmers.
- Interface has been designed keeping in mind the education and skills of the farmer. So, that they can easily access our application.

PROBLEM STATEMENT

- The figures in 2015 and 2016 showed an average of **more than 10 suicides daily**. Reason for most suicides is lack of funds and not having a good harvest.

- As only the merchants in metro cities can sell their products online, small town merchants face the scarcity of resources thus resulting in reduced sales.

So, to solve these issues and to help the farmers we are going to develop an application which will help farmers in getting the best yield out of the available resources.

FARMERS' SUICIDES
(includes those by farm labourers)

	2015	2016*	% Chg
Punjab	124	271	**118.0**
Haryana	162	250	**54.32**
Karnataka	1,569	2,079	**32.50**
Gujarat	301	408	**35.5**
Madhya Pradesh	1,290	1,321	**2.4**
Telangana	1,400	645	**-54.0**
Maharashtra	4,291	3,661	**-15.0**
Andhra Pradesh	916	804	**-12.2**
Chhattisgarh	954	682	**-28.5**
Total	**12,602**	**11,370**	**-9.8**

Note: Total might not match as all states have not been included Source: Parliament questions

MOTIVATION

- Looking at the disturbing numbers of the suicides and due to the exploitation of the farmers we the team of Annadata thought of developing this application.
- Due to digitalization, there has been a steep reduction in the sales of local merchants, as they don't have platform to sell their products online.

SCOPE OF THE PROJECT

- Prediction Of Harvest Yield Before Season
- Crop Prediction
- E-mart for Farmers
- Government Schemes
- Soil Quality Checks
- Kisaan Calculator

LITERATURE REVIEW

Paper	Name	Description	Inference
1.	**Crop Yield Prediction Using Machine Learning (2019)**	In this paper, authors have used various machine learning algorithms for crop yield prediction, temperature prediction and rainfall prediction and outcome of these techniques are compared on basis of MSE.	▪ Found out that Random forest is best option for crop prediction ▪ Simple recurrent neural network(RNN) for rainfall prediction ▪ Long short-term memory networks(LSTM) for temperature prediction.
2.	**Machine Learning and Statistical Approaches used in Estimating Parameters that Affect the Soil Fertility Status(2018)**	In this Paper authors have identified various parameters that could affect soil quality indirectly or directly using various machine learning algorithms.	▪ Using district wise soil data and incorporating in our dataset we can achieve a greater accuracy in crop harvest prediction ▪ Cation Exchange Capacity, S index, Soil organic carbon, Soil water retention capacity are the factors which affect crop quality

Paper	Name	Description	Inference
3.	**Problems Faced by the Farmers in Adoption of Mitigation and Adaptation of Climate Change Practices in Agriculture (2016)**	In this paper, the Authors analyzed the problems faced by the farmers in adoption of mitigation and adaptation of climate change practices in agriculture. They took a sample size of 60 farmers, by way of proportionate random sampling method.	▪ Lack of information on appropriate adaptation option was the most prioritized problem that was identified through this research paper. This was due to poor mass media usage and poor information seeking . ▪ Also, availing crop insurance by farmers is a great hurdle due to lot of proofs and paper works where farmers are not so accustomed with.
4.	**Prediction of Crop Production using Ada-Boost Regression Method (2019)**	In this paper, Author analyzed the various method used for estimation of crop that can grow in the region using Adaboost.	▪ Ensemble Techniques outperforms other algorithms and can be considered for model building.

Paper	Name	Description	Inference
5.	**Predicting Yield of the Crop using Machine Learning Algorithm (2018)**	In this paper, authors have used various machine learning algorithms to predict crop yield using various independent variables like rainfall, temp etc.	▪ Random Forest is the best suited algorithm. ▪ We came to know that Independent variables such as rainfall, district, temp, hectares ,etc can be used to train model
6.	**Use of Deep Neural Networks for Crop Yield Prediction on Soyabean Plants (2019)**	In this paper, the Authors analyzed the problems faced by the farmers and tried to solve it with CNN and LSTM.	▪ LSTM based models do good as it holds the time sensitivity of the data points like rainfall, temperature etc. ▪ LSTM works good in sequential data. ▪ LSTM is complex to implement.

Paper	Name	Description	Inference
7.	**Supervised Machine learning Approach for Crop Yield Prediction in Agriculture Sector(2020)**	In this paper, the Authors analyzed different machine leaning algorithms like Random forest and Decision Trees and came out with the best out of them.	▪ Random Forest Regressor is giving best results for crop yield prediction. ▪ Also, learned about various data pre-processing techniques that can be used to clean the data.
8.	**Predictive Analysis to Improve Crop Yield using a Neural Network Model(2018)**	In this paper, Author beautifully analyzed the Rainfall analysis using Time Series approach and used Recurrent Neural Network for soil feature modelling.	▪ ARIMA model can be used to model Rainfall analysis as it is time series data itself. ▪ Then the model can be used in the RNN (Recurrent neural network) for soil features modeling.

Paper	Name	Description	Inference
9.	**CRY – An improved Crop Yield Prediction model using Bee Hive Clustering Approach for Agricultural data sets (2013)**	Authors of this paper have used CRY model which works on clustering . They have used this model or crop prediction	• CRY uses clustering to predict the crop yield
10.	**Fuzzy Logic based Crop Yield Prediction using Temperature and Rainfall parameters predicted through ARMA, SARIMA, and ARMAX models(2019)**	Crops are sensitive to various weather phenomena such as temperature and rainfall. Therefore, these features are used for prediction. In this work, three methods are used to forecast- ARMA (Auto Regressive Moving Average), SARIMA (Seasonal Auto Regressive Integrated Moving Average) and ARMAX (ARMA with exogenous variables).	▪ For Rainfall Prediction ARMA/ ARMAX model was used , the accuracy of predictions made for rainfall by ARMA model is better than ARMAX model. ▪ For Temperature prediction ARMA/SARIMA model was used, temperature is best predicted by the SARIMA model ▪ It was observed that temperature prediction accuracy was greater as it depends on less factors as compared to rainfall which is hard to predict.

Paper	Name	Description	Inference
11.	**Rice Crop Yield Prediction Using Artificial Neural Networks (2016)**	In this paper , Authors have developed ANN model for predicting yield of rice during kharif season and kept the parameters precipitation, minimum temperature, average temperature ,into consideration to calculate RMSE , RAE and RRSE which then were used to compute F1-Score and MCC	• Based on their study , they found out that ANN with backpropagation works best in such cases • It gives a higher accuracy when compared with linear regression as these factors are affecting the yield non-linearly.
12.	**Crop Yield Prediction based on Indian Agriculture using Machine Learning (2020)**	In this paper , Authors have developed a stacked regression model for prediction of variety of crops that are planted all over India, and they have taken simple parameters like state , district , season and area to predict the production.	• Based on their study , they decided to use Lasso , Ridge and ENet • These models were stacked to form a stacked regression model and the new model gave less RMSE

Paper	Name	Description	Inference
13.	**Crop Yield Prediction and Efficient use of Fertilizers (2019)**	In this paper, the authors analyze the various farming related attributes like location, pH value from which alkalinity of the soil is determined. Along with it, % of nutrients is also calculated with the use of third-party applications like APIs for weather and temperature, type of soil, nutrient value of the soil, amount of rainfall, soil composition etc. All these attributes are used to develop a model and predict the yield.	• Crop production analysis is processed by implementing both the Random Forest algorithm and Backpropagation algorithm • Crop yield prediction and efficient use of the fertilizer is successfully predicted and found that the random forest is the more efficient algorithm from both the algorithms and obtained the most efficient output of the yield
14.	**Analysis of Soil Behavior and Prediction of Crop Yield using Data Mining Approach (2015)**	In this paper, the authors performed experiments using two important classification algorithms K-Nearest Neighbor (KNN) and Naive Bayes (NB) and applied them to soil dataset. Accuracy is obtained by evaluating the datasets. Each algorithm is then run over the training dataset and their performance in terms of accuracy is evaluated.	• Classification of soil into low, medium and high categories are done by adopting data mining techniques in order to predict the crop yield using available dataset • This study will help the soil analysts and farmers to decide sowing in which land may result in better crop production.

MARKET REVIEW

- Available and Working
- Available and not Working
- Proposed

Feature/App	**Annadata**	AgriCentral	Kisan Suvidha	Agro Star	Krishify	AgriApp	Bharat Agri	Agrivi	Farm Key
	Proposed	Features							
Prediction of Harvest	✓						✓		
Soil Quality Check	✓					✓	✓		
E-mart for Farmers	✓		✓	✓	✓	✓			✓
Government Schemes	✓	✓	✓	✓	✓	✓	✓		✓
Calculator	✓								
Dashboard	✓								✓
UI in Hindi	✓	✓	✓	✓	✓		✓		
One District One Cluster	✓								

USE CASE DIAGRAM

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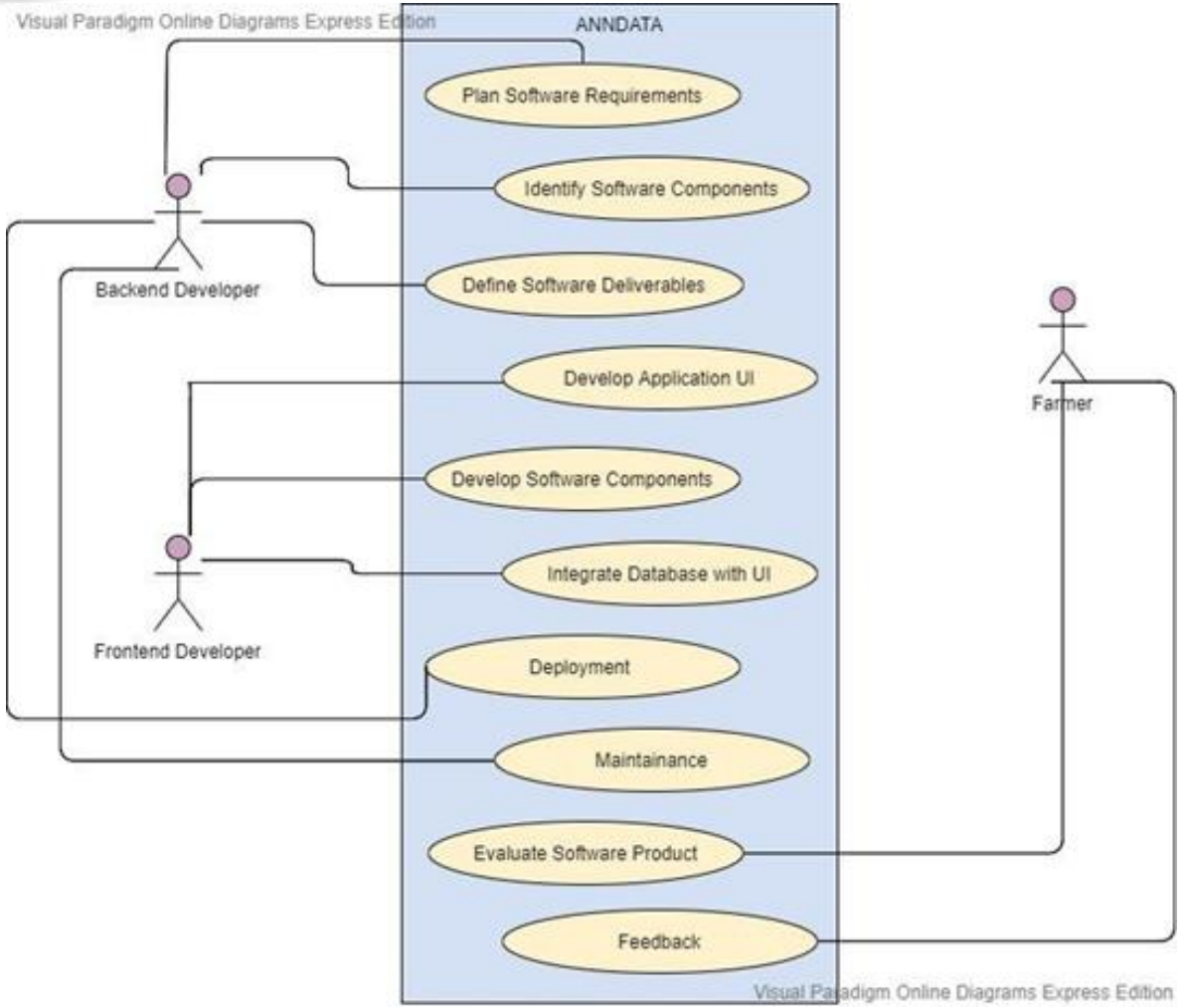

PROJECT FLOW

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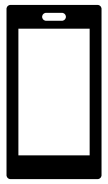
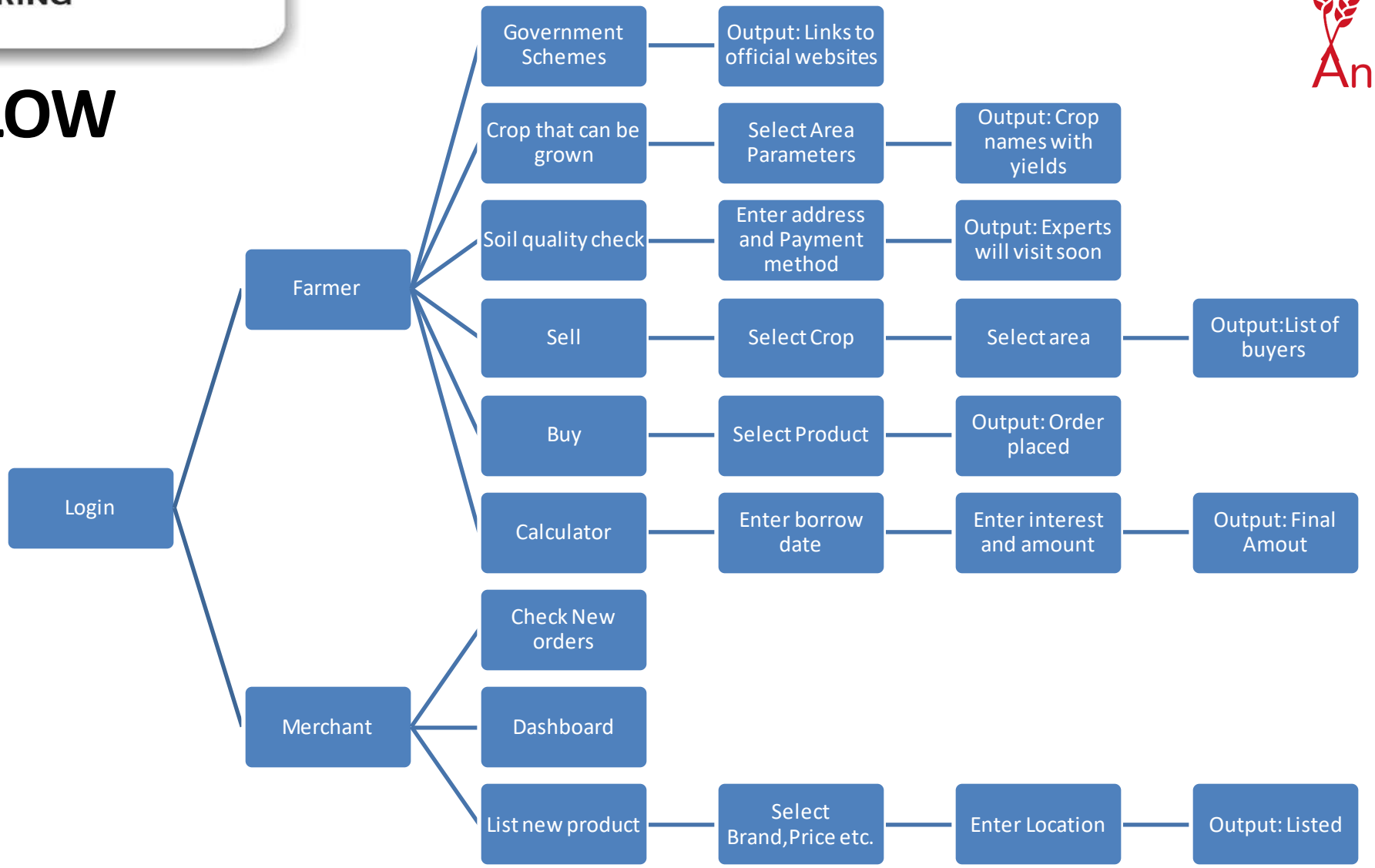
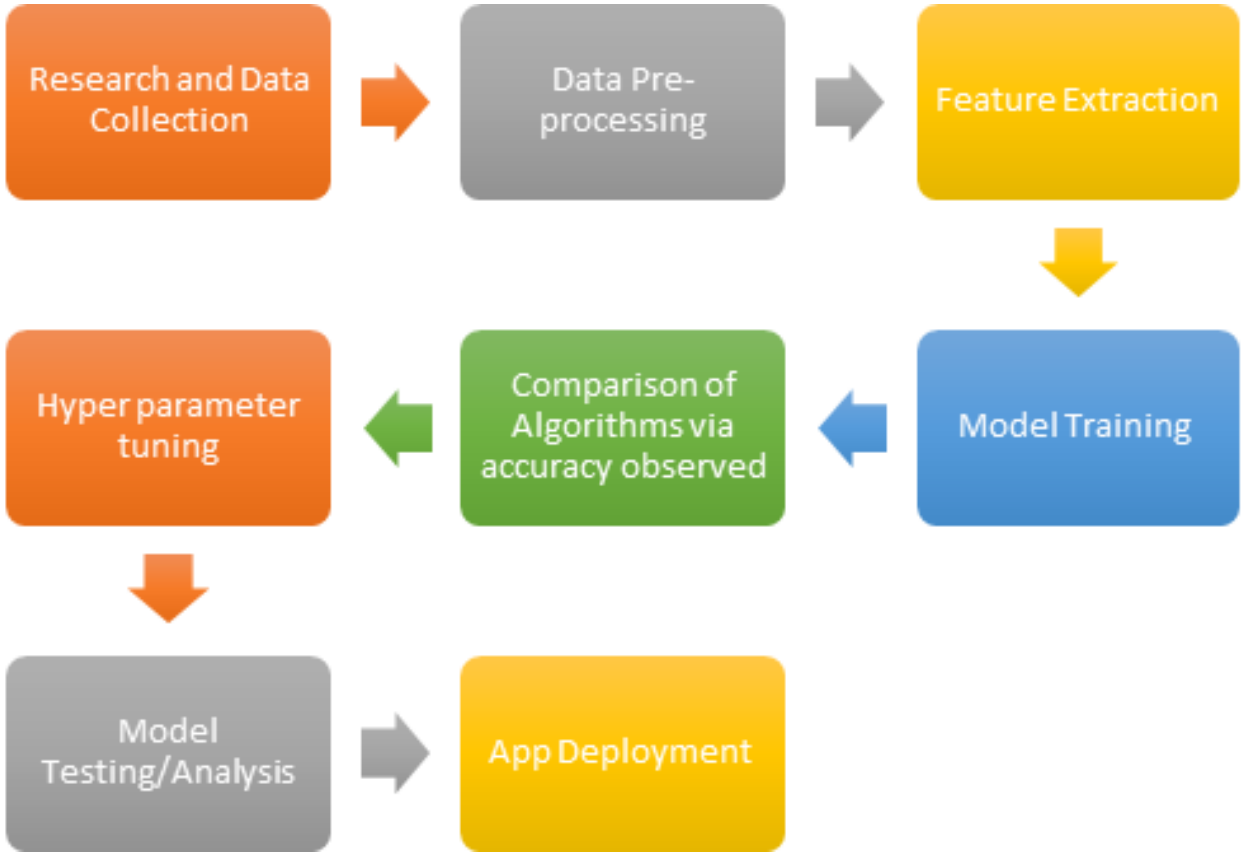
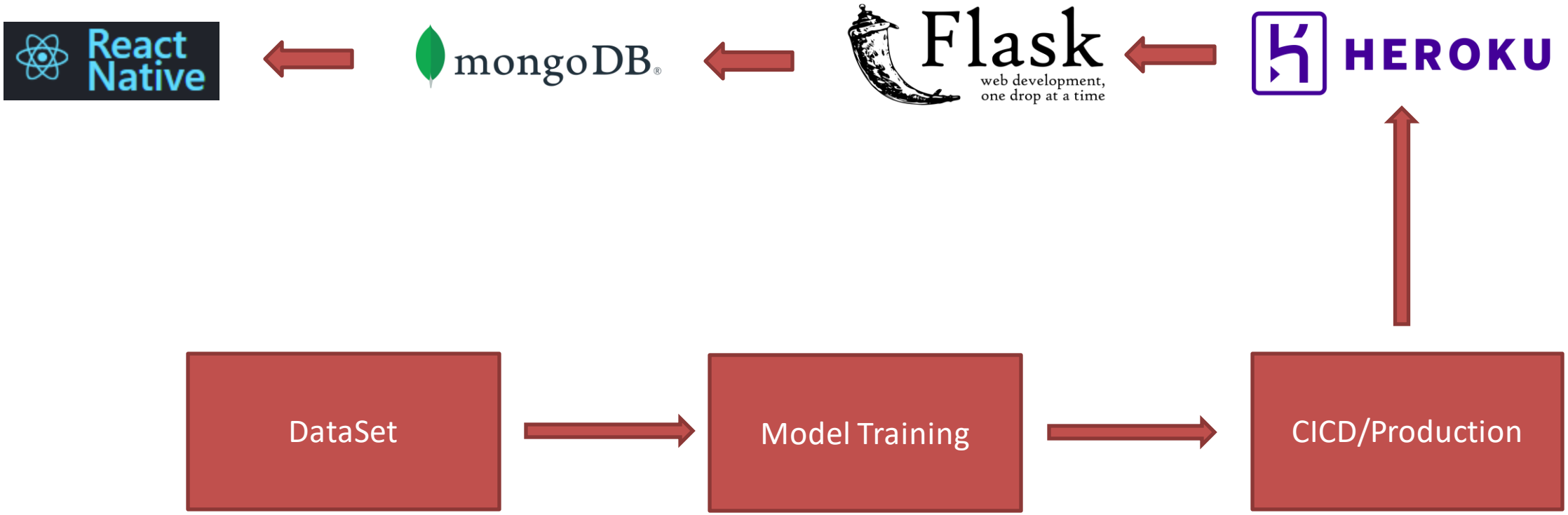




PROPOSED ARCHITECTURE



TECHNOLOGY APPROACH



CROP YIELD PREDICTION

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	District	Year	Crop	Area	Production	Rainfall	Season
0	ajmer	2004	Arhar/Tur	3	21929.827885	452.8	Kharif
1	ajmer	2004	Bajra	82174	41736.000000	452.8	Kharif
2	ajmer	2004	Castor seed	18	7.000000	452.8	Kharif
3	ajmer	2004	Cotton(lint)	12327	24170.000000	452.8	Kharif
4	ajmer	2004	Groundnut	2378	584.000000	452.8	Kharif
5	ajmer	2004	Jowar	119921	30195.000000	452.8	Kharif
6	ajmer	2004	Maize	37783	27330.000000	452.8	Kharif
7	ajmer	2004	Moong(Green Gram)	79619	32496.000000	452.8	Kharif
8	ajmer	2004	Moth	1868	173.000000	452.8	Kharif
9	ajmer	2004	Other Kharif pulses	2259	308.000000	452.8	Kharif

Dataset Size: 5758 Rows, 7 Columns

-Initially we are focusing on all Districts of Rajasthan

-We have created a new dataset from 3 different data sets i.e., Soil, Rainfall and Area.

CROP YIELD PREDICTION

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Dataset Before Pre-Processing:

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Other Kharif pulses	2.0	1.0
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0
3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0
4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0

Dataset After Some pre-Processing:

(Handling Missing value(Production), Label-Encoding)

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production
0	0	427	2000	1	2	1254.0	2000.0
1	0	427	2000	1	74	2.0	1.0
2	0	427	2000	1	95	102.0	321.0
3	0	427	2000	4	7	176.0	641.0
4	0	427	2000	4	22	720.0	165.0

ALGORITHM FOR CROP YIELD PREDICTION

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- We worked upon multiple algorithms to achieve the best possible accuracy by comparing their Root Mean Square Values which after reading several research papers and comparing our results we found to be Random Forest Algorithm

```
Mean Absolute Error: 7355.213307137326
Mean Squared Error: 539937166.5945281
Root Mean Squared Error: 23236.548078286673
```

RESULT

```
rf=RandomForestRegressor()
rf_randomcv=RandomizedSearchCV(estimator=rf,param_distributions=random_grid,n_iter=100,cv=3,verbose=5,
                               random_state=100,n_jobs=-1)
### fit the randomized model
rf_randomcv.fit(X_train,y_train)
```

```
import numpy as np
from sklearn.model_selection import RandomizedSearchCV
random_grid={'n_estimators':[50,100,200,300],'criterion':["mse", "mae"],
        'max_depth':[50,60,70,80,90,100,150,200],'min_samples_split':[2,4,6,8,10,20,30,40,50],
        'min_samples_leaf':[1,2,3,4,5,6,7,10,20,40,50]}
print(random_grid)
```

```
{'n_estimators': [50, 100, 200, 300], 'criterion': ['mse', 'mae'], 'max_depth': [50, 60, 70, 80, 90, 100, 150, 200], 'min_sampl
es_split': [2, 4, 6, 8, 10, 20, 30, 40, 50], 'min_samples_leaf': [1, 2, 3, 4, 5, 6, 7, 10, 20, 40, 50]}
```

CODE

RESULT ANALYSIS

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❑ Result Analysis:

We decided to use 3 Regression Metrics to compare the results that is:
1)Mean Absolute Error (MAE)
2)Mean Squared Error (MSE)
3)Root Mean Squared Error (RMSE)

```
Mean Absolute Error: 8494.035592437016
Mean Squared Error: 532621192.7758147
Root Mean Squared Error: 23078.58732192711
```

XgBoost Results

```
Mean Absolute Error: 7355.213307137326
Mean Squared Error: 539937166.5945281
Root Mean Squared Error: 23236.548078286673
```

Random Forest Results

```
52009.97761003149
```

RMSE- Neural Networks Results

```
62218.462553806574
```

RMSE- LSTM-RNN

CROP PREDICTION

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Alluvial_Soil	23-03-2021 03:54 PM	File folder
Black_Soil	23-03-2021 03:55 PM	File folder
Clay_Soil	23-03-2021 03:55 PM	File folder
Red_Soil	23-03-2021 03:55 PM	File folder

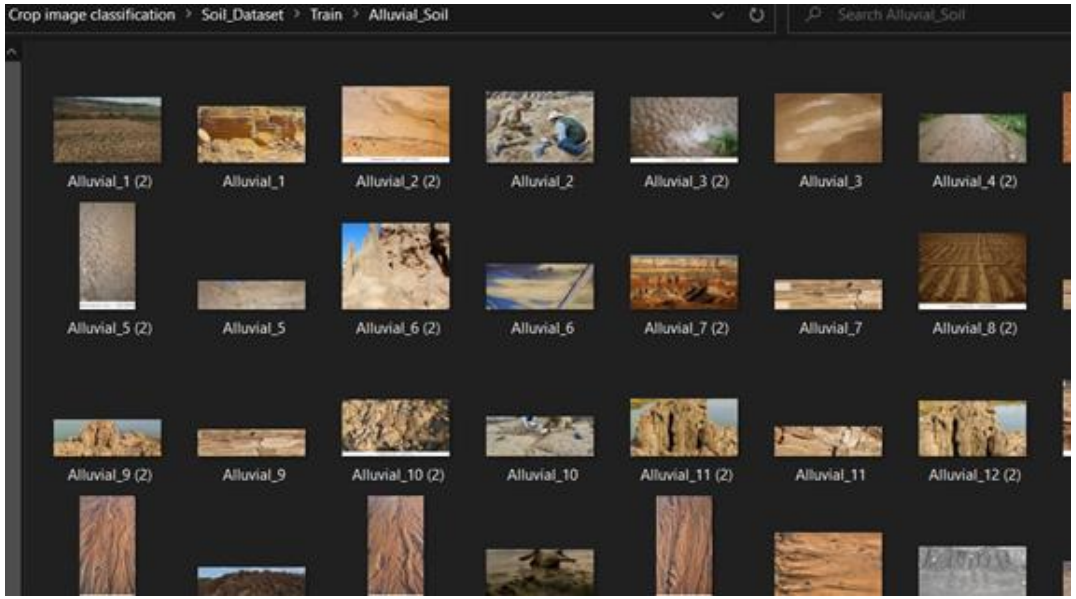

Image Data

	A	B	C	D	E	F	G	H	I	J
1	S. No.	Name of Distirct	Fertility Status			Problematic Soil		Annual Normal Rainfall in mm	Soil type	Ph
2			N	P	K	Saline Soil (Ha)	Sodic or Alkali Soil (Ha)			
3	1	Ajmer	L	M	H	16712	1983C	601.8		
4	2	Jaipur	L	M	H	74224	117474	563.8		
5	3	Dausa	L	M	M	4056	38437	561.0		
6	4	Sikar	L	M	M	59936	30036	440.3	Desert soil	High
7	5	Jhunjhunu	VL	M	M	1596	27612	405.0	Desert soil	High
8	6	Alwar	L	M	M	15976	97625	657.3		
9	7	Bharatpur	L	M	M	32613	45217	663.9		
10	8	Dholpur	L	M	M	5373	20121	744.5		
11	9	S.madhopur	L	M	M	12530	20027	873.4		
12	10	Karauli	L	M	M	7002	7200	709.4		
13	11	Bikaner	VL	M	M	14134	14033	243.0	Dunes and associated	
14	12	Churu	VL	M	M		250	354.7	Desert soil	High
15	13	Sriganganagar	VL	M	M	14000	5100	226.4	Desert soil	High
16	14	Hanumangarh	L	M	M	14214	6517	273.5	Desert soil	High
17	15	Jodhpur	M	M	H	2902	9527	313.7	Desert soil	High

Soil Content Data

CROP PREDICTION

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```
mobilenet = tf.keras.applications.MobileNetV3Small(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top= False)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/mobilenet_v3/weights_mobilenet_v3_smal
6701056/6698480 [==============================] - 0s 0us/step
```

```
mobilenet.summary()
```

```
Model: "MobilenetV3small"
_________________________________________________________________________________________________
Layer (type)                 Output Shape              Param #     Connected to
=================================================================================================
input_2 (InputLayer)         [(None, 224, 224, 3) 0
_________________________________________________________________________________________________
rescaling (Rescaling)        (None, 224, 224, 3)  0           input_2[0][0]
_________________________________________________________________________________________________
Conv (Conv2D)                (None, 112, 112, 16) 432         rescaling[0][0]
_________________________________________________________________________________________________
Conv/BatchNorm (BatchNormalizat (None, 112, 112, 16) 64          Conv[0][0]
_________________________________________________________________________________________________
tf.__operators__.add (TFOpLambd (None, 112, 112, 16) 0           Conv/BatchNorm[0][0]
_________________________________________________________________________________________________
re_lu (ReLU)                 (None, 112, 112, 16) 0           tf.__operators__.add[0][0]
_________________________________________________________________________________________________
tf.math.multiply (TFOpLambda)   (None, 112, 112, 16) 0           re_lu[0][0]
```

Accuracy-95%

Final Algorithm- mobilenetv3 small.

Crop prediction feature is to help farmer predict which crop to grow according to soil type. We tried to integrate one district one cluster dataset with the 4-type picture dataset but was becoming too heavy for the app. So, we decided to use crop prediction with help of image classification.

We used **VGG16, resnet50, mobile net v3 large and small**

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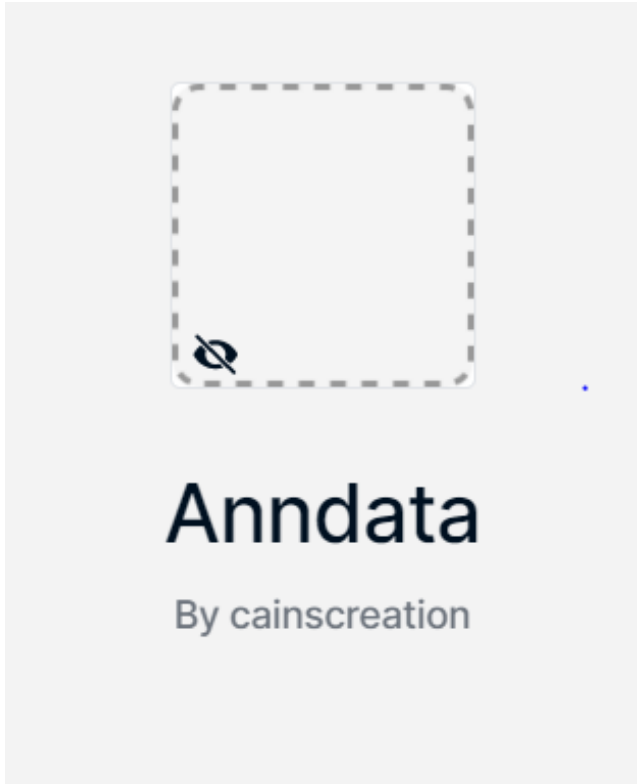
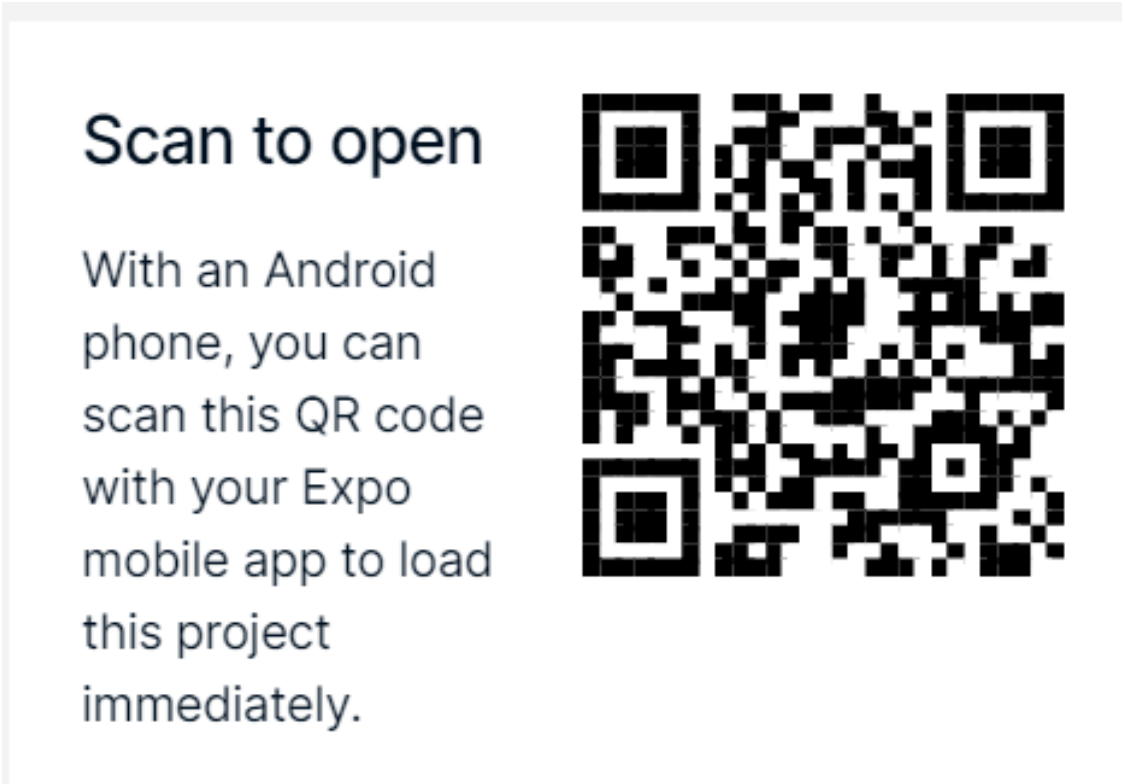
APPLICATION-DEMO – EXPO GO





E-Mart

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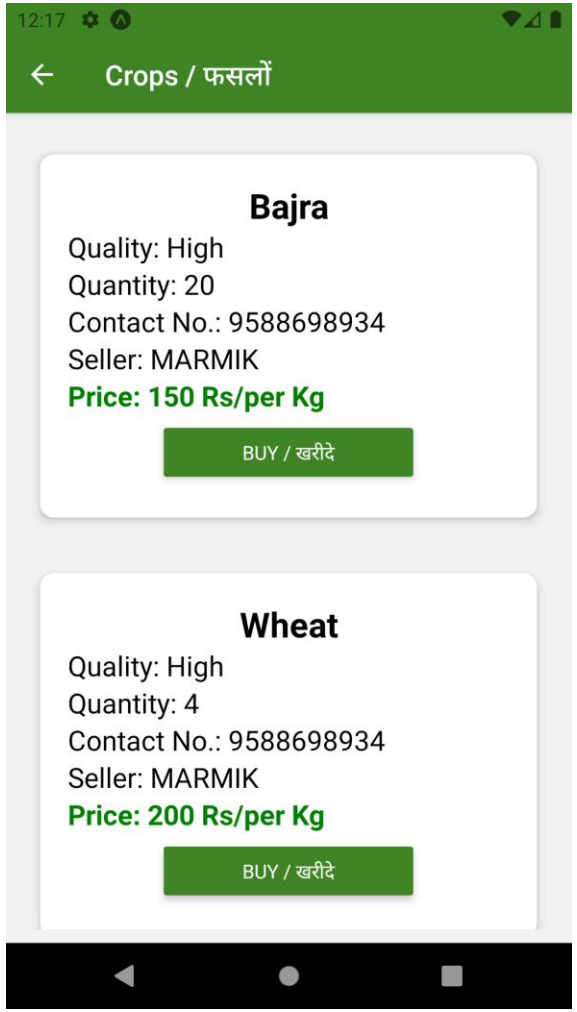
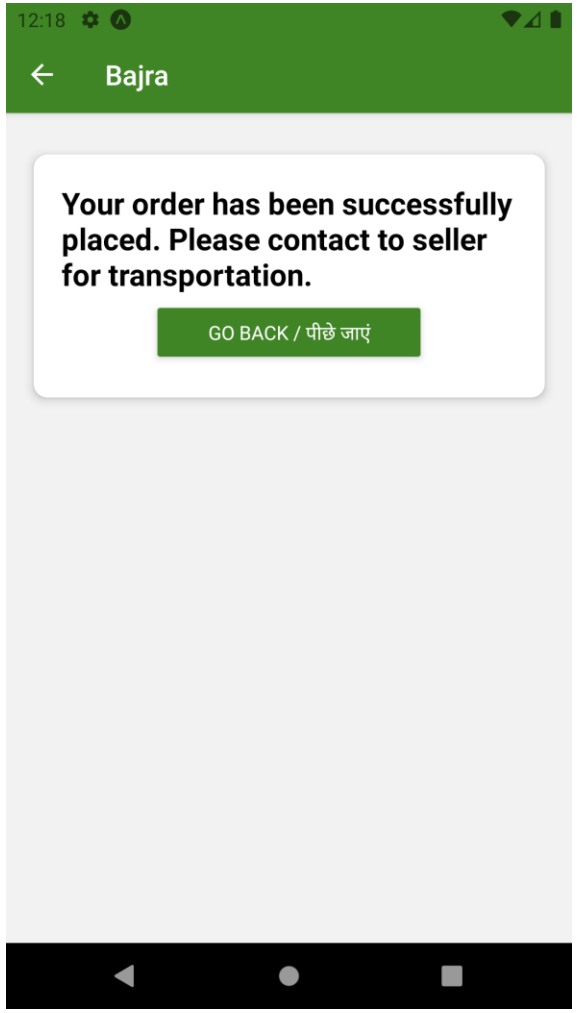
```
_id: ObjectId("60712cca55998c54ef467ad2")
Crop_Name: "Bajra"
Crop_quality: "High"
Crop_quantity: 20
Price: 150
Mobile: 9588698934

_id: ObjectId("6071308955998c54ef467ad4")
Crop_Name: "Wheat"
Crop_quality: "High"
Crop_quantity: 4
Price: 200
Mobile: 9588698934

_id: ObjectId("6071352f19b4e2bae816b1a4")
Crop_Name: "Gehu"
Crop_quality: "High"
Crop_quantity: 500
Price: 50000
Mobile: 6350678395
```

Crop Seller Data-Backend(MongoDB)



Crop Buyer UI



Final Response Page

GOVERNMENT SCHEMES

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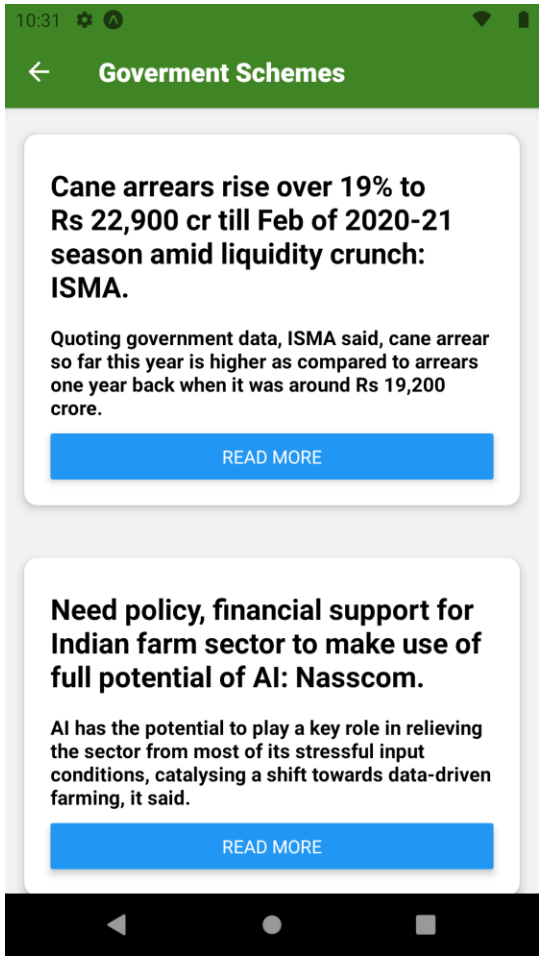
```
import requests
from bs4 import BeautifulSoup
import requests
from bs4 import BeautifulSoup
import json


def Farmer_News_header():
    H = []
    url = "https://economictimes.indiatimes.com/topic/Indian-farmers/news"
    href = "https://economictimes.indiatimes.com"
    page_request = requests.get(url)
    data = page_request.content
    soup = BeautifulSoup(data, "html.parser")

    for divtag in soup.find_all('div', class_='clr flt topicstry story_list'):
        for h2 in divtag.find_all('h2'):
            H.append(h2.text + '.')
    for i in range(len(H)):
        return H
```



We've scrapped data from The Economic Times website using Beautiful soup.

SOIL QUALITY CHECK

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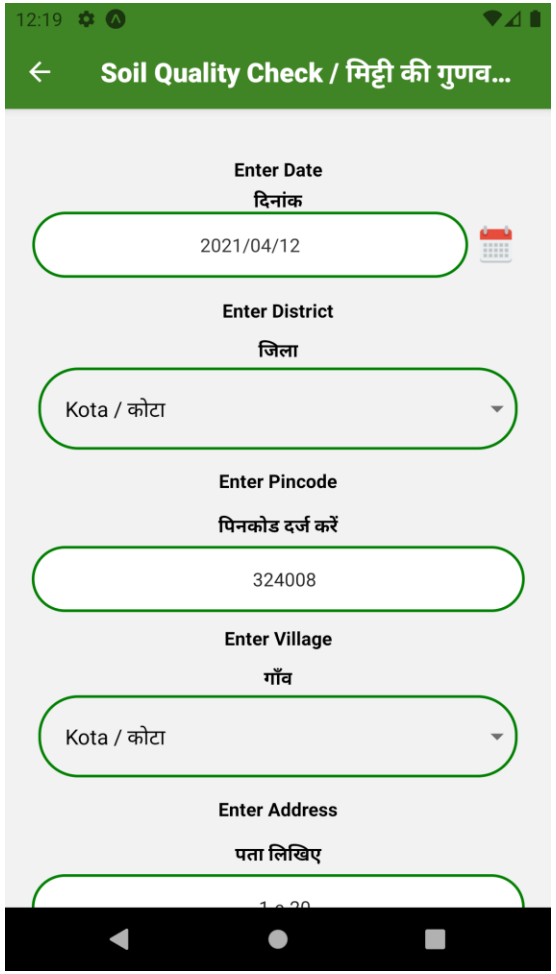
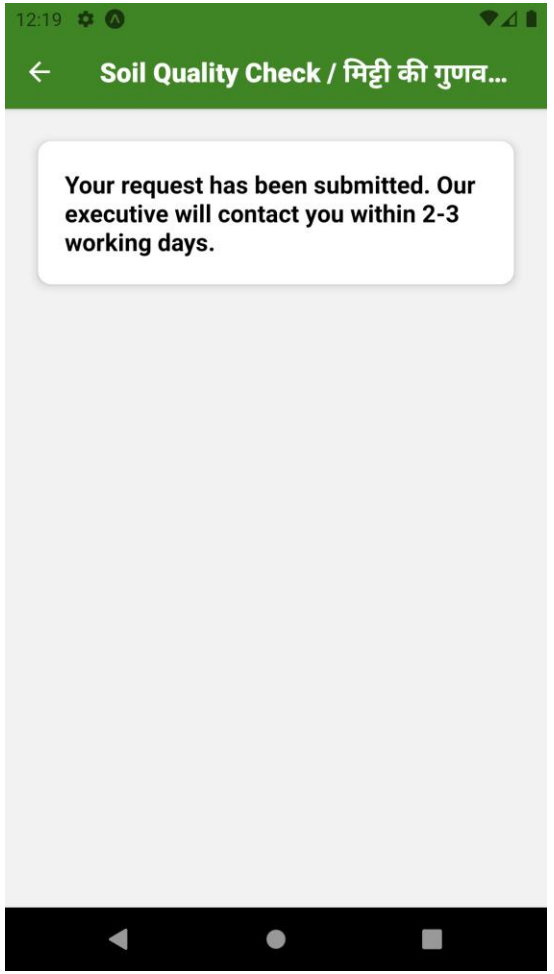
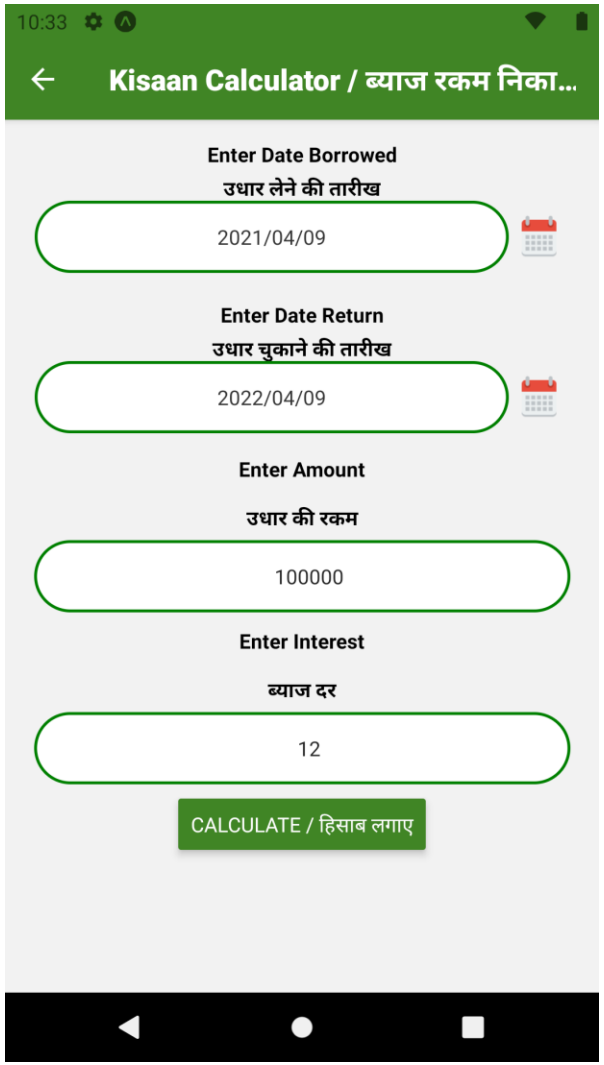
Farmer can request for Soil quality check to get better insights and predictions on basis of their soil type and quality.





KISAAN CALCULATOR

- Through this feature we are trying to make farmer aware
- Farmers are being charged interests on the day basis.
- We used Simple interest formula to calculate final amount.



BACK-END IMPLEMENTATION

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Database Schema(MongoDB-Atlas)

Collections

CREATE COLLECTION

Collection Name	Documents	Avg. Document Size	Total Document Size	Num. Indexes	Total Index Size	Properties
Agri__equipment	1	144.0 B	144.0 B	1	36.0 KB	
Fertilizers	1	119.0 B	119.0 B	1	24.0 KB	
Order_table	2	130.5 B	261.0 B	1	32.0 KB	
crop	4	111.0 B	444.0 B	1	36.0 KB	
login	5	56.2 B	281.0 B	1	36.0 KB	
merchant	1	138.0 B	138.0 B	1	36.0 KB	
seeds	1	121.0 B	121.0 B	1	36.0 KB	
soil_quality_check	1	131.0 B	131.0 B	1	36.0 KB	

Database View(MongoDB-Compass)

anndata.Agri__equipment

Documents Aggregations Schema Explain Plan

FILTER { field: 'value' }

ADD DATA VIEW

```
_id: ObjectId("60712f1519b4e2bae816b19f")
Brand: "Tvs"
Quantity: 1
Price: 1000000
Image: "Image "
Agricultural_equipment_n… : "Tractor"
Mobile: 6350678395

_id: ObjectId("6071314d55998c54ef467ad5")
Brand: "Tcs"
Quantity: 1
Price: 500000
Image: "Image"
Agricultural_equipment_n… : "Threaser"
Mobile: 8955638632

_id: ObjectId("60713ac155998c54ef467ad6")
Brand: "mahindra"
Quantity: 1
Price: 5500000
Image: "img"
Agricultural_equipment_n… : "tractor testing"
Mobile: 9079370785
```

API IMPLEMENTATION

Annadata

app.py | requirements.txt | Procfile

```python
from flask import Flask,request,jsonify,json
from bson import json_util, ObjectId

import numpy as np
import pymongo
from bson import ObjectId

# Replace your URL here. Don't forget to replace the password.
connection_url = 'mongodb+srv://shivam:shivam@cluster0.cn03q.mongodb.net/test'
app = Flask(__name__)

client = pymongo.MongoClient(connection_url)

# Database
Database = client.get_database('anndata')
# Tables

crop_table = Database.crop
login_table= Database.login
merchant_table=Database.merchant
Agri__equipment_table=Database.Agri__equipment
Fertilizers_table=Database.Fertilizers
soil_quality_check_table=Database.soil_quality_check
seeds_table=Database.seeds
mobile_number = None
#merchant_id = None
```

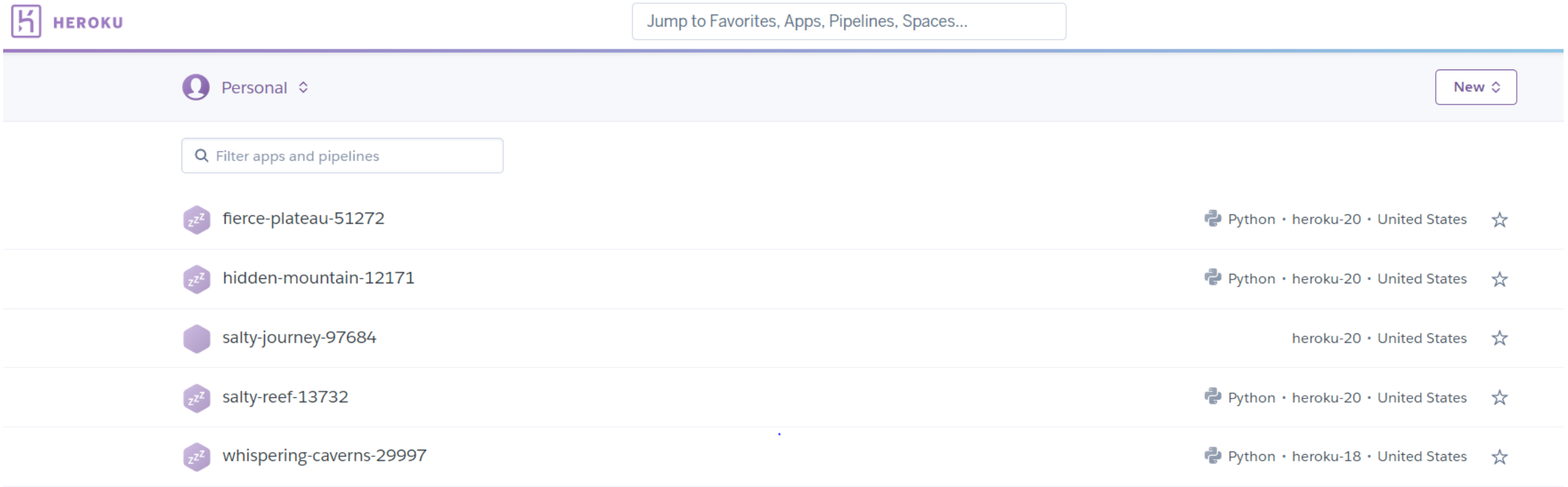
```python
from flask import Flask, request, jsonify
import os
from News import Farmer_News
import numpy as np
app = Flask(__name__)

@app.route('/news_api', methods=['POST'])
def news_api():
    output = Farmer_News()
    print (output)


if __name__ == '__main__':
    app.run(debug=True, use_reloader=False)
```

DEPLOYMENT-HEROKU

Annadata



FUTURE WORK

Annadata

- We will work on the efficiencies of the prediction and classification algorithms.
- Also, we will add the GPS feature in buy/sell section so that farmers can get local buyers/sellers easily.
- We will add new widgets and drop downs to make the app more efficient to use.
- Finally, we will also add some more regional languages in a planned manner so that users from other states can use it as well.

IMPACT

Annadata

- Our application will indirectly focus on reducing the suicide rates of the farmers by increasing their Per Capita income.
- Our app will remove various barriers and hassle which farmers face while buying/selling various products related to farming.
- It will help them become more aware , organized through various features introduced in our application.
- For merchants also, it will cut their raw materials cost as there is no involvement of broker and it will give them various opportunities to expand their businesses by selling their products online to a massive population of farmers.

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To gain a deep insight into our topic, we referred few research papers as well as some datasets which helped us in understanding the basis of our project.

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THANK YOU