AGRO- A DIGITAL GUIDE TO FARMERS

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Abstract- Agriculture is a vital part of any developing country's economy. Agriculture accounts for more than half of all job opportunities in India. Weather, yield, pricing, and soil quality are the most important factors for farmers to consider during the crop cultivation cycle. The goal of this project is to create a simple, yet informative application that includes all of the necessary information, such as weather conditions, yield selection, best market rates, and so on, in order to provide farmers with a thorough and comprehensive guide to help farmers make informed decisions, reduce losses, and improve the overall quality of agriculture and farmland.

Index Terms – forecasting, machine learning, prediction, support vector machine, multiple linear regression, artificial neural networks.

1. INTRODUCTION

Agriculture is extremely important in a developing country like India. Weather, yield, and price projections can be obtained using a variety of approaches, including prediction programmes, private websites, and government data. However, most farmers in India either do not have access to such information or are not technically proficient enough to extract it. Despite the fact that all of the necessary data may be retrieved and compiled from a variety of sources, there is no unified platform that can provide weather, yield, and price forecasts, as well as crop scheduling information for a specific district and crop, all in one location.

Our research aims to address this issue on a micro level by analysing weather data from the Indian Meteorological Department and studying previous models for predicting rainfall, humidity, temperature, and crop yield in order to develop the most optimal model for improving farmers' and agriculture's livelihoods today.

Because of its non-linearity, meteorologists have always had a hard time predicting the weather. Predicting rainfall accurately has implications for both agriculture and natural calamities such as landslides and floods. Knowing about these events ahead of time allows for the evacuation of certain areas, the implementation of preventative measures, and the minimization of financial losses. Because of the changing nature of the weather, forecasting rainfall is challenging.

Temperature and humidity are two more characteristics that influence a region's weather. The degree of hotness or coolness in a region is measured by temperature. Humidity refers to the amount of water vapour in the air in a given area. Weather has a significant impact on agricultural output. Each crop has an optimal weather condition connected with it, and by predicting the weather ahead of time, we can also predict which crops will thrive in a particular climate, optimising the farmer's yield.

Weather forecasting has traditionally relied on numerical approaches and the solution of equations for various atmospheric parameters. Because the atmosphere is fluid in nature, the next state of the fluid could be anticipated by solving these equations of fluid dynamics using partial differentiation and thermodynamics. Due to the unpredictable nature of the weather, this would be difficult to do. These equations could not only be solved completely, but the time required to do so was so short that it would result in more inaccuracies due to the weather changing dramatically in the same time period. However, thanks to recent technological breakthroughs, we no longer need to rely on such time-consuming ways to generate forecasts.

Machine learning is the usage and development of computer systems that can learn and adapt without being explicitly programmed. Machine learning algorithms and statistical models are used to uncover hidden patterns in historical datasets and derive conclusions from them. Machine learning is a branch of artificial intelligence that allows models to improve in accuracy over time and by fine-tuning them without needing to be explicitly programmed to do so. As a result, we may use technology to create machine learning models that can forecast the weather in a short amount of time, and the model will learn from incorrect predictions through time and training to increase accuracy.

Predicting agricultural yields is another aspect of our research. Knowing how many seeds are best for a given land area, as well as how much yield can be expected from a given sowing season, can help farmers reduce the burden of storing, selling, and importing/exporting their agricultural produce, as well as reduce the amount of money they need for a given batch of produce.
Due to the abrupt, chaotic, and harsh weather processes that occur in the region, South India is the most influenced by climate changes. We concentrated our research on the southern Indian states of Kerala, Andhra Pradesh, Karnataka, and Tamil Nadu. We'll start with one state and grow the machine learning model from there, eventually optimizing it for the entire country.

2. PROBLEM STATEMENT

To create a simple, user-friendly, multilingual application for farmers that predicts rainfall, temperature, and humidity in a given region over a given period of time, as well as crop yield in a given acre of land, in order to optimize the agriculture industry through the use of a digitalized approach. The app will incorporate insurance plans as well as other vital information that might help farmers avoid losses and opportunities while also enhancing their livelihood.

3. PROPOSED SOLUTION

We have proposed a flutter-based app which would be cross-platform i.e it’ll support both android and IOS operating systems. For the database, we’ve used firebase.

Flowchart for our proposed solution is given below-

We have broadly divided our solution in 3 modules-

3.1. User Interface (UI)-

3.1.1. Onboarding Screen:- The application is open-source, so users can simply log in with their mobile numbers. The application supports both Hindi and English languages, so the user can choose according to his or her needs.

3.1.2. Yield Prediction Screen:- A crop's yield is derived from two factors, first by determining the amount of land that has been cultivated, and second by knowing the past yield of that particular crop. Result numbers are expressed as metric tons.

3.1.3. Smart Connect:- This is the place where all farmers can learn about crops and their specifications that have been posted by their fellow farmers. In a way, this works like a social network for farmers. In addition, users of the app have access to upload details of their crops, which are then accessible to other users.

Crop/Food Description(Each crop card: Image, Name, M.S.P, Quantity, Description)

3.1.4. Feed:- Farmers can directly access these government schemes here, since all government schemes related to agriculture will be listed here, and they can click on them to learn more. A Helpline is also available to farmers, which they can use as needed or as desired

3.2. Crop Yield Prediction- Machine learning model chosen is Support Vector Regressor (SVR). This model was chosen on the basis of our academic research and after comparing different regression techniques. The way that SVR works is that the model produced depends only on a subset of the training data, because the cost function for building the model does not care about training points that lie beyond the margin, i.e. this model doesn't start performing bad because of outliers and other anomalies in the input data. Conclusively, the model produced by SVR depends only on a subset of the training data.

\[
\text{minimize} \quad \frac{1}{2} \|w\|^2 \\
\text{subject to} \quad y_i - \langle w, x_i \rangle - b \leq \varepsilon
\]

where \( x_i \) is a training sample with target value \( y_i \). The inner product plus intercept \( \langle w, x_i \rangle + b \) is the prediction for that sample, and \( \varepsilon \) is a free parameter that serves as a threshold: all predictions have to be within an \( \varepsilon \) range of the true predictions.

The regression model is built using the scikit-learn python library which has all these machine learning models perfectly designed. The model takes in 26 parameters out of which 24 are rainfall values and the other 2 are land area and production to land area ratio. The production refers to the volume of crop that the farmer had grown in the past season. The land area also has to be the utilized land area on which the farming was done. The output of the model is a float value, denoting farm yield value. It's unit is metric tonnes.

3.3. Weather Prediction- The forecast is done using the public API of openweathermap.org. An hourly
forecast is being made for the next 5 days. All the essential weather data is being presented beautifully on the app which helps farmers make essential decisions regarding starting the farming process.

4. METHODOLOGY

Agile methodology allows the continuous iteration of development and testing throughout the software development life cycle of the project.

The working software is the primary measure of progress. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely. Continuous attention to technical excellence and good design enhances agility. Simplicity—the art of maximizing the amount of work not done—is essential. The best architectures, requirements, and designs emerge from self-organizing teams. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

There are 3 modules in our system. Each module works as follows:

Module 1: Prediction of Crop Yield
1. In this particular module, the information regarding the rainfall conditions of that region, farm land area and previous yield information will be considered which would be used in the system.
2. After getting the rainfall data, the predicted value of yield will be displayed to the farmer in a seamless manner.

Module 2: Smart Connect
1. Using the interface, farmer can enter the details of the crops grown by him.
2. The fellow farmers who have registered themselves in the system can search for the desired crops in the system.
3. In this way, farmer-to-farmer communication builds up.

Module 3: Feed and Weather Forecasting
1. This module keeps the farmers updated about new methods, technology, agriculture related News and tips.
2. Also an hourly forecast is being made for the next 5 days.
3. This helps farmers make essential decisions regarding starting the farming process.

4.1. Software Requirements
4.1.1. Application frontend- Flutter Apk
4.1.2. Database- Firebase
4.1.3. UI- Figma
4.1.4. IDE- Visual Studio Code
4.1.5. Languages- Python, Dart

4.2. Hardware Requirements
4.2.1. Computer
➢ Core i5 processor
➢ 8GB RAM
➢ SSD
➢ HD Display
4.2.2. Keyboard

5. ANALYSIS

* 5.1 Feasibility Study

5.1.1 Technical Feasibility- Technical feasibility examines the available technical resources (software and hardware) and aids in the decision-making process. whether or not the technical team has the ability to convert transforming concepts into practical systems The application software Flutter and Python are crucial components for our project, which is implemented using Visual Studio Code as the IDE and firebase as the database.

5.1.2. Economic Feasibility- This refers to making a project cost-effective and efficient while keeping a close eye on its cost/ benefit analysis. Our project does not require any expensive platform or hardware for its deployment hence it is economically feasible.

5.1.3. Legal Feasibility- This evaluation looks into whether any component of the proposed project is in violation of legal requirements such as data protection laws. Because all of the essential data is freely available to anyone in the globe, the project does not involve any unlawful activities. Furthermore, agreeing the terms and conditions is the only way to use all of the software requirements.

5.1.4. Operational Feasibility- This assessment involves undertaking a study to analyze and determine whether—and how well—the farmer’s needs can be met by completing the project. The main objective of the project is proper
suggestion of various crops to the farmers by testing weather. In addition to this, the business communication between the farmers and vendors would be enhanced using our project.

5.2. Features-
❖ Multi-lingual
❖ Cross-Platform
❖ Simple and elegant UI
❖ Smart Connect
❖ Farmer’s Helpline Support

6. RESULTS

Onboarding Screen

Multi Language Support

Crop Prediction (Parameters)
Crop Prediction (Result)

Smart Connect

Farmer-to-Farmer Connect

Uploading of crops details
Feed related to agriculture

7. REFERENCES

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