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ShetiMitra- An Interactive System to Predict Crop Yield along with Profit and Loss to Help Farmers using Deep Learning

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Abstract: *According to the latest available data, agriculture is a significant sector in India, employing over 55% of the country's total workforce. This highlights the crucial role that agriculture plays in India's economy and the livelihoods of its citizens. The majority of Indian farmers continue to practice traditional farming, which can make them vulnerable to various challenges. Market fluctuations, a lack of knowledge about soil health and the crops best suited for it, as well as insufficient information about crop conditions and market prices, can all hinder a farmer's ability to maximize their yields. Consequently, many farmers are experiencing losses due to these issues. Efficient planning and management of agricultural activities are crucial for farmers to optimize their crop yields and profits. To achieve this, accurate predictions of crop yield, profit, and loss are essential. By utilizing data-driven techniques such as soil quality analysis, weather forecasting, and market analysis, farmers can make informed decisions that help them maximize their profits and minimize losses. This can be achieved through the use of precision agriculture techniques, which rely on advanced technologies such as drones, satellite imaging, and machine learning algorithms to gather and analyze data on soil health, crop growth, and market trends.*

Keywords: Decision making, Feature Extraction Deep Learning, Crop Yield Prediction, Soil Analysis

I. INTRODUCTION

ShetiMitra is a solution to major problems faced by farmers in India, such as unpredictable weather, fluctuating markets, and lack of knowledge about the best soil for crops and soil health. It is a platform designed specifically to assist Indian farmers in making informed decisions. It consists of four modules that provide a comprehensive toolkit for agriculture. The Soil Research Module uses advanced soil science findings to evaluate soil health, nutrient profiles, and composition. By incorporating a pH sensor, farmers can accurately measure soil pH levels, which are crucial for determining soil fertility and nutrient availability. This datadriven approach improves crop selection, soil management, and resource allocation, promoting sustainable agricultural practices. The Weather Forecasting Module offers detailed insights into climatic patterns, helping farmers adapt their agricultural practices for optimal productivity. Through data collection, analysis, and modelling, farmers receive recommendations for mitigating weather-related risks and maximizing crop yields. The Crop Resource Dynamics Module focuses on the specific resource requirements of different crops, taking into account factors such as soil type, climate, weather patterns, and crop health. By utilizing data analytics and machine learning algorithms, it provides accurate predictions and recommendations for resource allocation, irrigation, fertilization, and pest management. As a result, there are less waste and greater yields. The Price Prediction/Market Module concentrates on predicting crop prices in the Mumbai Vashi Market. It analyses historical data, market demand and supply, weather patterns, government policies, and global trends to provide reliable price predictions. This can help farmers in making knowledgeable choices regarding their crops. These modules empower farmers with knowledge and insights to optimize profitability, reduce risks, make better decisions, and increase efficiency in their agricultural operations. ShetiMitra is committed to providing unbiased and positive responses, demonstrating its dedication to empowering farmers and promoting sustainable agricultural practices for a brighter future.

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The agricultural production mainly aims to generate high yield for the crops [1]. Prediction of the crop on a global scale and regional scale is highly important for the agriculture management sector, crop farmers, food trade policies and carbon cycle research [2], [3]. To maintain the high demand and secured level of food chain supply to the people, the prediction of crop yield is a national priority for the government. For example, India has major crop production of rice and wheat, the Ministry of Statistics and Program Implementation (MOSPI) conducted three surveys on the Improvement of crop statistics related to crop yield as observed from 2011–18, to improve the technical guidance to the state for obtaining reliable and timely crop yield estimation, [4]. Also, low populated countries consider the crop yield as an important area to attain economic stability though agro-trade.

II. LITERATURE SURVEY

For our project we are surveying some reports and references which are helping us to make it easy and simplest and they are as follows

Yang Tan [1] introduce, This study examines how well the Continuous Wavelet Transform method removes Sliding mode control effects from VIS-NIR spectrum and Soil Organic Content measurement techniques. Trials reveal the optimal wavelet filter, disintegration ratio, and Soil Organic Matter regions. The authors proposed utilizing PCA-RF to create Soil Organic Matter predictions using multi-scale correlations and tested if it improves estimating methodologies. The optimum Continuous Wavelet Transform size and number of PCs retrieve soil organic components from wet specimen spectra. Finally, the Continuous Wavelet Transform was considered for spectrum adjustment. The decomposition parameters can be improved to identify noise-distorted or spectra-inconspicuous properties of the primary component.

The multipath stage of the NavIC L5 signal as well as proportional soil water content of farmland are described by Sushant Shekhar [2]. The study demonstrates that the NavIC signal is quite sensitive to changes in soil water content. The results show that NavIC signals can be a useful instrument for determining the amount of moisture of agricultural land areas. The estimates are predicated on data gathered over a lengthy period of time. With the devised approach, the amplitude fluctuation of a multipath transmission was noticed. The mirrored output from the capacitive surface of the ground affects the C/N0, creating multipath frequency fluctuation. With the assistance of a soil moisture sensor, in presence quantitative soil moisture information was gathered, which would have been necessary to create an alignment with the input signal. The NavIC multipath stage and in situ observed macroscopic soil water content had a strong connection in this investigation. The results of the study may be used to construct a soil moisture extraction method using NavIC multipath information for use in drought surveillance, climate change research, groundwater recharge, farming, and other fields.

Varsha Kiran Patil [3] indicates that This paper proposes a method for soil evaluation in Pune, Maharashtra, India. R, G, and B values from color detectors are kept in the cloud. The contractor's color palette shows these quantities. Any qualified user may access all real-time cloud parameters for heat, moisture, relative humidity, R, G, and B location. Producers can utilize permitted API rights on their phones to examine soil attributes. Real-time cloud-based soil nutritional and component monitoring near Pune (India) has proved successful. Instead of soil analysis lab results, farmers may use this platform to get real-time soil properties[8].

Deep Learning: A Background The Revolution of Deep learning started when AlexNet won the ImageNet large scale visual recognition challenge in 2012 (ILSVRC), with the 85% accuracy by the large margin upon the 74% runner-up algorithm Support Vector Machine (SVM) model [16]. Due to the use of adding more layers, the accuracy has improved in model depth. Increasing the layers of the network gradually raises the memory size. GoogLeNet has introduced deeper 22 layers of inception model, balancing effective computational [17]. ResNet is a residual learning framework forming a network of 152 layers to achieve efficient training in Deep Learning.

Yield Prediction of Crop Nowadays precision agriculture with wireless sensor network is advancing [24], and a review on the applications with various aspects of agriculture using WSN is proposed by the Rehman [25]. Whelan observed that precision agriculture aims to gather information for providing better decision making, related to time and space [26]. The soil fertility prediction with artificial neural networks is proposed by Song [27]. Using ANN, the neural networks can cope with the complex mapping using input variable set.

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III. METHODOLOGY

ShetiMitra is an innovative platform designed to support Indian farmers in their decision-making process. Our platform offers four distinct modules to help farmers make informed choices. Comprising four pivotal modules, ShetiMitra delineates a strategic approach to address the multifaceted facets of agricultural forecasting

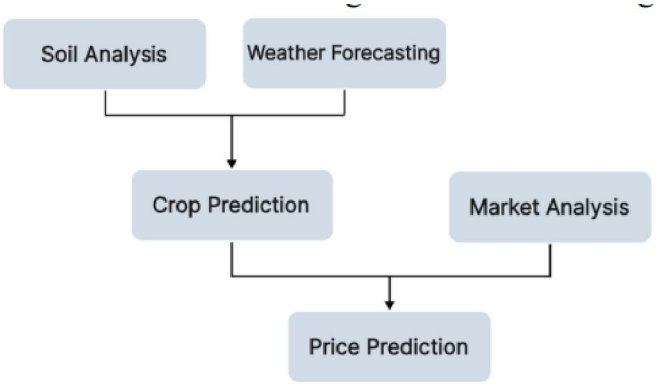

Fig. 1. Block Diagram

3.1 Soil Research Module

The platform's soil research module utilizes most recent soil science findings to help farmers assess soil health, nutrient profiles, and composition. This information enables farmers to make informed decisions about crop selection, soil management, and resource allocation, ultimately leading to improved crop yields and sustainable agricultural practices. The pH sensor is a crucial component of the platform's soil research module, as it allows for accurate measurement and monitoring of soil pH levels. Soil pH is a critical factor in determining soil fertility and the availability of essential nutrients for plants. Different crops have specific pH requirements, and maintaining the optimal pH level can significantly improve crop yield and overall plant health. The pH sensor measures the hydrogen ion concentration in the soil solution, providing a quantitative measure of acidity or alkalinity on a scale from 0 to 14. If the pH is lower than 7, the soil is acidic; if it is higher than 7, the soil is alkaline. Neutral soil has a pH of 7.

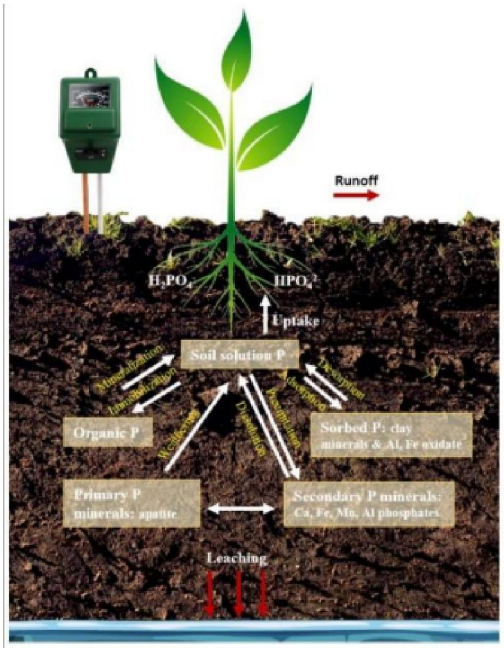

Fig. 2.Soil Research module

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Incorporating a pH sensor into the soil research module offers several benefits:

1. Enhanced crop selection: By measuring soil pH, farmers can identify which crops are best suited for their land, ensuring optimal growth conditions and increased yields
2. Improved soil management: Regular pH monitoring helps farmers detect changes in soil chemistry and adjust their management practices accordingly. For example, they may apply lime to raise pH or sulfur to lower pH, promoting better nutrient availability and reducing the risk of nutrient toxicities or deficiencies.
3. Efficient resource allocation: Accurate pH measurements enable farmers to allocate resources more effectively by targeting areas requiring amendments, reducing unnecessary inputs and costs.

3.2 Weather Forecasting

The second module concentrates on the impact of weather conditions on crop yield. Over a fourmonth/crop period, we gather comprehensive weather data and offer in-depth insights into climatic patterns. This information helps farmers adapt their agricultural practices to optimize productivity.

1. Data Collection: Gather a comprehensive dataset containing weather variables such as temperature, precipitation, humidity, wind speed, and sunlight hours for a specific geographical region over a four-month period. You may also want to collect crop yield data for the same time frame and location.
2. Data Preprocessing: Clean and preprocess the dataset by removing any missing or inconsistent values. Convert data types if necessary and normalize the data to ensure comparability between different variables.
3. Exploratory Data Analysis (EDA): Perform EDA to identify trends, correlations, and patterns in the data. Visualize the data using charts, graphs, and heatmaps to gain insights into how weather variables affect crop yield.
4. Feature Engineering: Create new features from existing ones to better capture the relationship between weather variables and crop yield. For example, you could create a "growing degree days" feature to measure the accumulated heat available for crop growth.

Fig. 3.Weather Forcasting

3.3 Crop Resource Dynamics Module

The crop resource dynamics module searches into the complications of various crops and their resource requirements. ShetiMitra synthesizes information on crop-specific necessities, providing farmers with a strategic framework for optimized resource allocation and yield outcomes. Machine Learning Framework The platform's machine learning framework harnesses the power of Artificial Neural Networks, Long Short-Term Memory (LSTM) Neural Networks, and a Hybrid model to deliver precise crop yield predictions. Rigorous empirical validation has demonstrated the

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superior performance of these methodologies compared to conventional approaches, making ShetiMitra a necessary tool for the agricultural community. Sustainable advancement of agriculture by providing farmers with accurate predictions of crop yields and associated profit and loss.ShetiMitra contributes significantly to the sustainable advancement of the agricultural sector. The platform's informal approach to agricultural management helps farmers optimize their resources, reduce waste, and minimize environmental impact, ensuring a brighter future for our planet. At ShetiMitra, we are committed to providing socially unbiased and positive responses that are respectful, helpful, and honest. Our goal is to empower farmers with the knowledge they need to succeed in their endeavours.

3.4 Price Prediction/Market

This module focuses on crop price prediction from the dataset, a critical agricultural marketplace. By analysing complex market dynamics and utilizing data from dataset, we provide farmers with accurate price predictions, enabling them to make informed decisions about crop selection and pricing strategies.

- **Overview of the Module:** This module of the platform is designed to provide farmers with accurate and reliable crop price predictions. The module utilizes a combination of machine learning and data from dataset, a leading agricultural marketplace, to analyse complex market dynamics and generate price predictions for various crops.
- **Purpose of the Module:** The main purpose of this module is to empower farmers with the information they need to make informed decisions about crop selection and pricing strategies. By providing accurate and reliable price predictions, farmers can better understand the market demand and supply dynamics, and adjust their cultivation and sales strategies accordingly. This can help farmers maximize their profits, reduce risks, and improve their overall livelihoods.
- **Functionality of the Module:** The crop price prediction module functions by analyzing a wide range of factors that affect crop prices. These factors include:
- **Historical price data:** The module utilizes historical price data for various crops in the dataset to identify patterns and trends that can help predict future price movements. 2. Market demand and supply: The module analyzes market demand and supply data to understand the current and future demand for various crops, which can impact crop prices. 3. Weather and climate data: Weather and climate data, such as temperature, rainfall, and soil moisture, can impact crop yields and quality, which in turn can affect crop prices.
- **Benefits of the Module:** The crop price prediction module offers several benefits to farmers, including: 1. Improved profitability: By providing accurate and reliable crop price predictions, farmers can make informed decisions about crop selection and pricing strategies, which can help them maximize their profits. 2. Reduced risks: The module helps farmers mitigate risks by providing them with insights into market dynamics and price movements, which can help them, avoid losses due to unexpected price fluctuations. 3. Better decision-making: The module empowers farmers with data-driven insights that can help them make better decisions about their crops, including what crops to grow, when to sell, and at what price. 4. Increased efficiency: By providing farmers with real-time market data and price predictions, the module can help farmers streamline their operations and improve their overall efficiency. By using linear regressions, we can predict the price very efficiently.
- **Conclusion of this module:** The crop price prediction module is a critical component of the platform, as it provides farmers with the information they need to make informed decisions about their crops and maximize their profits. By leveraging data from BajarSamiti and utilizing machine learning algorithms, the module generates accurate and reliable crop price predictions that can help farmers thrive in the competitive agricultural market.

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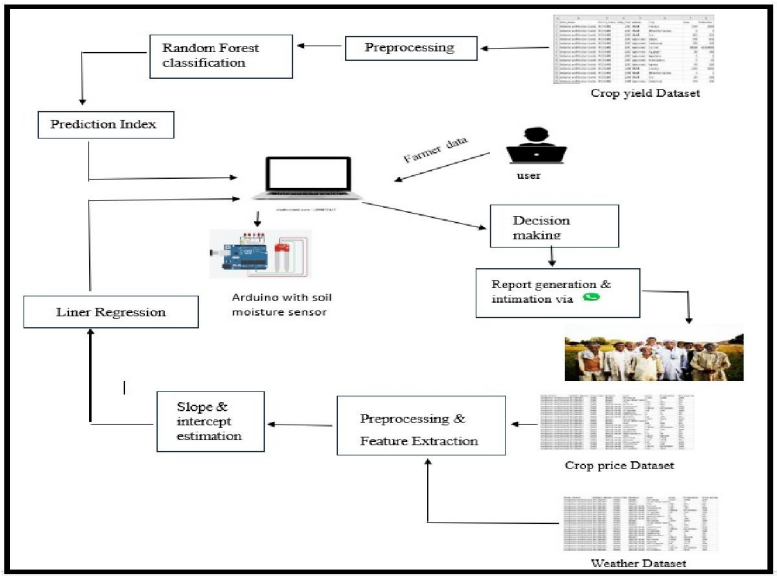

Fig. 4. Block Diagram

IV. CONCLUSION

In conclusion, the importance of farming for feeding people worldwide, especially in countries like India, is very high. The introduction of "ShetiMitra" complete system using machine learning, is a big step forward in predicting farming outcomes. ShetiMitra helps farmers make better decisions about crops yield based on, prices prediction, weather prediction, and soil health.

V. FUTURE SCOPE

1) Fertilizers suggestions with respect to crop life cycle.
2) Using weather API forecasting future weather for that particular location.
3) By using thermal camera, find the water level in crop.
4) Use of monthly market data for prediction of accurate price.
5) Identifying Crop diseases by using live images of crops.
6) Resources suggestions for maximum crop yield.
7) The Proposed model can be deployed to analyse vast dataset for all the region of India using highly efficient Deep learning models like transformers in cloud
8) The proposed model can enhance to work as mobile app connected to live cloud, that can be used by the farmers at their location with handy NPK kit
9) The Proposed model can be enhanced to send the report to the farmers of different states of India in their regional language by including UNI code library and certification in the application

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