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DEPARTMENT OF INFORMATION TECHNOLOGY

IT5311 Programming and Data Structures Laboratory

MINI PROJECT

3/8 B.TECH INFORMATION TECHNOLOGY

PROJECT NAME : SoilMinds - SDG 15

TEAM :-

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INTRODUCTION:

Many farmers face challenges in determining the most suitable crops for their agricultural fields and identifying the appropriate pesticides for optimal crop yield. Factors such as soil properties play a crucial role in crop selection and pest management. However, the complexity of these factors can make decision-making challenging. The main goal of our project is to help farmers in managing these problems.

OBJECTIVES:

- **Crop Prediction :** Develop a predictive model that analyzes soil properties (e.g., pH, nutrient levels, temperature, humidity, rainfall) to recommend the most suitable crops for a given agricultural field.
- **Pesticide Recommendation :** Create a model that suggests appropriate pesticides based on the identified crops and prevailing environmental conditions.

TECHNOLOGIES USED:

a) React:

Functionality: JavaScript library for building user interfaces.

Key Frameworks/Packages:-

Create React App: Simplifies the setup and development of React applications.

React Router: Enables navigation and routing within the application.

b) Node.js:

Functionality: A runtime environment for executing JavaScript code on the server side.

Key Frameworks/Packages:

Express: A web application framework for Node.js, used for routing and middleware management.

Body-parser: Middleware to parse incoming request bodies.

nodemon: Monitors changes in the source code and automatically restarts the server.

c) Decision Tree:

Functionality: Used for crop recommendation based on input parameters.

Key Frameworks/Packages:

SQL database query visualization: Utilizing SQL to learn and visualize the data variations of the dataset for each crop, the decision tree was created.

d) JavaScript:

Functionality: The main programming language for both frontend and backend development.

Key Frameworks/Packages:

Babel: Transpiles modern JavaScript code into a version compatible with most browsers.

ESLint: Linting tool to maintain code quality and consistency.

JSX: For generating react components with integrated html in js using JavaScript XML(jsx).

e) CSS:

Functionality: Styling language for designing and formatting the appearance of the web application.

Key Frameworks/Packages:

CSS: utilizing normal css for enhanced loading animation and page visualization with meaningful crop and pesticide images.

CSS-in-JS libraries (e.g., styled-components): Enables styling components using JavaScript.

CONCEPTS USED:

a) Decision Tree:

Functionality: Represents the decision-making process for crop recommendation.

Key Frameworks/Packages:

Decision trees can be implemented using core programming ideas and libraries in the selected language.

b) Node and Edge Representation:

Functionality: Nodes represent decision points, and edges represent possible outcomes or choices.

Key Concepts:

Graph Theory: Concepts of nodes and edges derived from graph theory for decision tree representation.

c) Input Handling:

Functionality: Handling user input and passing it through the decision tree.

Key Concepts:

Form Handling: Techniques for collecting and validating user input.

d) Result Display Components:

Functionality: Organizing components for displaying the results.

Key Frameworks/Packages:

React Components: Inbuilt React components and custom components for rendering outcomes.

e) Scalability Considerations:

Functionality: Ensuring the scalability of the decision tree data structure.

Key Concepts:

Algorithmic Complexity: Selecting data structures and algorithms with optimal time and space complexity.

d) Optimization Techniques:

Functionality: Enhancing decision tree traversal and search for efficiency.

Key Concepts:

Pruning Techniques: Trimming unnecessary branches of the decision tree.

Time complexity: worst case $O(\log N)$.

Space complexity: $O(N)$.

e) Code Modularity:

Functionality: Ensuring modularity in the codebase.

Key Concepts:

Component-Based Architecture: Breaking down the application into reusable and independent components.

OUTPUT SCREENSHOTS:



The screenshot shows the homepage of SoilMinds. At the top, there's a dark green header bar with the SoilMinds logo on the left, and 'Crop Recommendation' and 'Fertilizer Recommendation' buttons on the right. Below the header is a large green section with the title 'Welcome to SoilMinds' in white, followed by the tagline 'Nurturing Tomorrow's Harvest Today'. At the bottom of this green section, there's a sub-section titled 'Explore the Future of Farming with SoilMinds'.

Explore the Future of Farming with SoilMinds

At SoilMinds, we're redefining agriculture by blending technology with the art of cultivation. Step into a world where your farm's potential is maximized, and every harvest becomes a success story.

Our Core Offerings:

Precision Crop Recommendations: Unleash the full potential of your fields with our precise crop recommendations. SoilMinds analyzes the nitrogen, phosphorus, and potassium ratios, ensuring your crops receive the tailored care they deserve.

Climate Intelligence: Understand your farm's environment like never before. SoilMinds considers crucial factors like humidity, temperature, pH value, and rainfall data to provide you with insights that elevate your farming strategies.

Fertilizer Insights: Make informed decisions with our fertilizer recommendations. SoilMinds goes beyond suggestions and provides actionable insights, ensuring your crops receive the nutrients they need for optimal growth.

Why SoilMinds?

Innovation at Your Fingertips: Embrace the latest advancements in agricultural technology. SoilMinds puts innovation directly in your hands, transforming the way you nurture your crops.

User-Friendly Experience: No need to be a tech expert. SoilMinds boasts an intuitive interface designed for every farmer. Navigate effortlessly and harness the power of technology with ease.

Sustainable Agriculture: Join a community of forward-thinking farmers committed to sustainable practices. SoilMinds isn't just a tool; it's a commitment to a brighter, more sustainable future for agriculture.

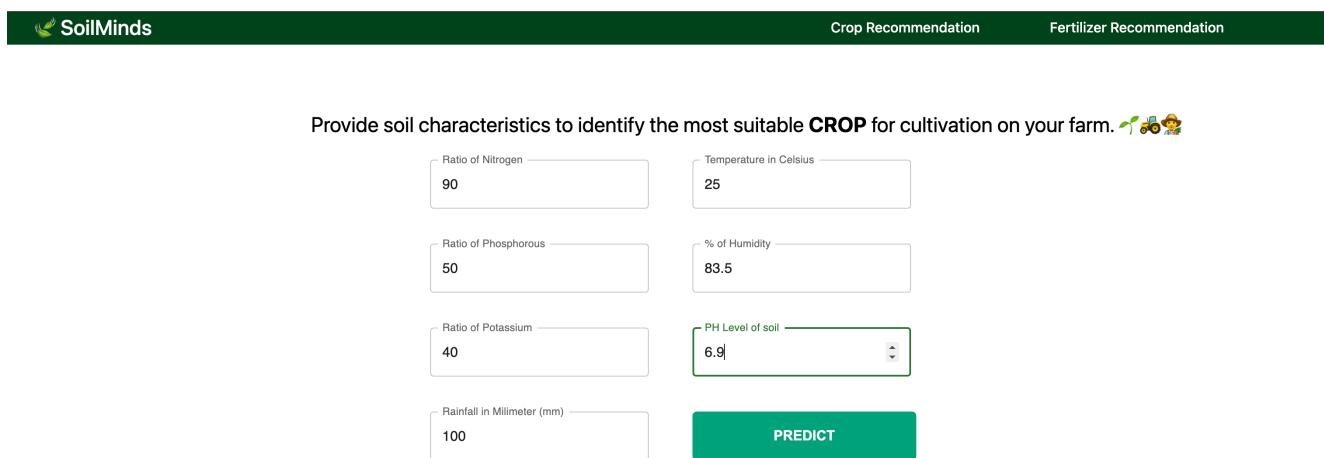
Ready to Transform Your Farming Experience?

Embark on a journey where technology meets the soil. Click the "Get Started" button below and open the door to a new era of farming.

Welcome to SoilMinds, where every seed planted is a step towards a thriving and sustainable harvest.

[Get Started Now](#)

This is the index page of our project. On clicking the “Get Started Now” button you will be redirected to the crop recommendation page.



The screenshot shows the 'Crop Recommendation' form page. At the top, there's a dark green header bar with the SoilMinds logo on the left, and 'Crop Recommendation' and 'Fertilizer Recommendation' buttons on the right. The main form area has several input fields for soil characteristics: 'Ratio of Nitrogen' (90), 'Temperature in Celsius' (25), 'Ratio of Phosphorous' (50), '% of Humidity' (83.5), 'Ratio of Potassium' (40), 'PH Level of soil' (6.9), and 'Rainfall in Millimeter (mm)' (100). A large green 'PREDICT' button is located at the bottom right of the form area. Above the form, there's a message: 'Provide soil characteristics to identify the most suitable CROP for cultivation on your farm.' followed by three small icons of a plant, a tractor, and a person.

After entering your soil's nutrient contents, temperature, humidity, PH level, and rainfall in mm, click the "PREDICT" button to identify the most suitable crop for your agricultural land.

 SoilMinds

Crop Recommendation Fertilizer Recommendation

You should grow **RICE** in your farm !



Rice is a highly adaptable crop that can thrive in a wide range of soil types, including those with high levels of nitrogen, phosphorous, and humidity. It is a great crop for farmers who want to make the most of their rainfall, as it is extremely efficient at using water and can yield up to 10 times more grain per unit of water compared to other cereal crops. Rice is also a great choice for farmers who are looking to diversify their crop rotation, as it can help to improve soil health by fixing nitrogen back into the soil. Plus, rice is a staple food for billions of people around the world, so with the right marketing strategy, you could potentially sell your rice for a premium price. And let's be real, who doesn't love a good bowl of rice? It's the perfect blank canvas for any type of dish, and it's super versatile - you can cook it in a rice cooker, on the stovetop, or even in the microwave. So if you're looking to add a tasty and profitable crop to your farm, consider giving rice a try. With the right soil conditions and a little bit of TLC, you could be well on your way to a successful rice harvest.

[Try again ?](#)

So, for the sample inputs that we gave in the crop details section, the suggested crop is "RICE". If you want to try it again click on the "Try again?" button.

For predicting the apt fertilizer for your land click on the "Fertilizer Recommendation" section on the header. You will be redirected to the fertilizer recommendation page.

 SoilMinds

Crop Recommendation Fertilizer Recommendation

Input information about your soil characteristics and the crop you're cultivating to discover the optimal **FERTILIZER** for your farm 

Ratio of Nitrogen 90	Temperature in Celsius 25
Type of Soil Black	Type of Crop rice
Ratio of Phosphorous 50	% of Humidity 83.5
Ratio of Potassium 40	Moisture in the soil 30

[PREDICT](#)

After entering your soil's details i.e. nutrient contents, temperature, humidity, type of soil, type of crop and moisture in the soil, click the "PREDICT" button to identify the most suitable fertilizer for your agricultural land.

 SoilMinds

Crop Recommendation Fertilizer Recommendation

You should use **10-26-26** fertilizer in your farm !



10-26-26 is a balanced blend of macronutrients, including 10% nitrogen, 26% phosphorus, and 26% potassium. These nutrients are essential for healthy plant growth and development. The nitrogen in 10-26-26 will help to promote strong stem and leaf growth, ensuring that your plants are able to photosynthesize efficiently and produce a good yield. The phosphorus in the fertilizer will support root development and help your plants to absorb essential minerals from the soil. Finally, the potassium will help to improve the overall health and hardiness of your crops, making them more resistant to stress and pests. But it's not just about the nutrients! The 10-26-26 formula is also specially formulated to be effective in a variety of soil types and climates. So whether you're growing in sandy soil, clay soil, or somewhere in between, this fertilizer will provide your crops with the nutrients they need to thrive. And with a little bit of TLC and some proper watering and weeding, you'll be well on your way to a bumper crop of delicious fruits and vegetables. So go ahead, give 10-26-26 a try on your farm. Your crops (and taste buds)

will thank you!

[Another Crop](#)

The suggested fertilizer for your land is "10-26-26". If you want to find the fertilizer for another crop click on the "Another Crop" button.

FUTURE OF THE PROJECT:

1) Integration of Machine Learning:

Implementing a machine learning model for crop and fertilizer recommendations can enhance accuracy and adaptability. You can use algorithms like Random Forests or Gradient Boosting for better prediction.

2) Dataset Expansion:

Continuously update and expanding the dataset with new crop and fertilizer information. This ongoing data collection will improve the model's learning capabilities and ensure its relevance over time.

3) Dynamic User Interface:

Implement a more dynamic user interface that allows farmers to visualize the decision-making process of the machine learning model. This can enhance user trust and understanding of the recommendations.

4) User Feedback System:

Integrate a feedback system for users to provide information on the success or failure of the recommendations. This data can be used for further refinement of the machine learning model.

5) Mobile Application Development:

Extend the project by developing a mobile application for farmers, making it more accessible and user-friendly for those who prefer using smartphones in rural areas.

6) Localization and Multilingual Support:

Consider adding localization features and support for multiple languages to make the application more accessible to farmers from diverse linguistic and cultural backgrounds.

7) Weather Forecast Integration:

Integrate real-time weather forecast data too enhance the precision of recommendations. Dynamic weather data can be crucial for accurate crop and fertilizer suggestions.

8) Community Building:

Create a platform for farmers to share their experiences, tips, and best practices. This community-driven approach can foster collaboration and collective learning among agricultural practitioners.

9) API Integration:

Develop APIs to allow third-party applications to access the crop and fertilizer recommendation system, fostering collaboration with other agricultural tools and services.

10) Machine Learning Model Updates:

Implement a mechanism for regular updates and retraining of the machine learning model to ensure it remains effective and adaptable to changing agricultural patterns.

11) Integration with IoT Devices:

Explore integration with IoT devices and sensors for real-time data

collection, providing more accurate and up-to-date information for the machine learning model.

12) Smart Notifications:

Implement a notification system that alerts farmers about optimal planting times, weather-related advisories, and other relevant information based on the machine learning predictions.

By incorporating these future enhancements, SoilMinds can evolve into a robust and comprehensive platform that not only provides crop and fertilizer recommendations but also becomes a integral part of the agricultural community, fostering collaboration and continuous improvement.