PES University
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Precision Agriculture

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ABSTRACT

The present project focuses on harnessing the power of Machine Learning (ML) techniques to enhance soil analysis and crop yield prediction through the examination of essential soil parameters, including Nitrogen (N), Phosphorus (P), Potassium (K), and soil moisture. By leveraging ML algorithms, we aim to generate high-accuracy predictions and real-time data with increased frequency, facilitating efficient and data-driven decision-making for farmers and agricultural stakeholders.

The project begins with an extensive data collection process, where soil samples are obtained from various agricultural regions, and corresponding NPK levels and soil moisture content are measured. A comprehensive selection of ML models, including regression, decision trees, random forests, and deep learning approaches, will be evaluated to identify the most suitable algorithm for predicting crop yield based on the given soil parameters. The models will be trained using historical data on crop yields and corresponding NPK and soil moisture values. To ensure robustness, the models will be fine-tuned and validated using cross-validation techniques.

Once the ML model with the highest accuracy is identified, a real-time data collection and prediction system will be developed and integrated into an easily accessible platform. Soil sensors placed in agricultural fields will continuously measure NPK levels and soil moisture, providing high-frequency updates. The ML model will process this data in real-time, generating instant crop yield predictions.

INTRODUCTION

Agriculture is a vital pillar of global food security and economic stability. With a growing population and changing climate conditions, the need for efficient and sustainable agricultural practices has become more crucial than ever. Precision agriculture, an innovative approach that leverages technology and data-driven solutions, offers great promise in optimizing resource usage and enhancing crop productivity. The project aims to harness the power of the Internet of Things (IoT) and Machine Learning (ML) to revolutionize traditional farming practices. By continuously monitoring key soil parameters, including Nitrogen (N), Phosphorus (P), Potassium (K), and soil moisture, this project enables farmers to make informed decisions based on real-time data.

WHY WE CHOSE THE TOPIC?

Through precision agriculture, we target to reach farmers with data-driven insights, transforming traditional farming into a smart and efficient practice.

1) Through precision agriculture, we target to reach farmers with data-driven insights, transforming traditional farming into a smart and efficient practice.
2) By leveraging ML to analyse soil parameters and predict crop yields, farmers can make more informed decisions, leading to better crop/resource management and increased productivity.
3) To help enable small scale farmers access new technologies through low-cost small implementations.

IMPLEMENTATION

After conducting thorough research and analysing various papers and articles, we have identified key aspects of our project that warrant targeted focus. Our objective is to devise a robust and feasible solution to address a specific problem effectively.

From our research, we recognized the significance of data processing and utilization, which we intend to implement through cloud-based systems. Additionally, we carefully examined the parameters within our control, such as crop yield and soil fertility, as well as external factors beyond our influence, like temperature.

A pivotal consideration in our approach was the pursuit of a cost-effective implementation while harnessing the full potential of modern computing power. This optimization aids in the collection and enhancement of data accuracy, ultimately leading to higher crop yields and improved soil fertility.

Drawing insights from the literature, we determined the optimal frequency of data analysis and identified the sensors essential for our purposes. Consequently, this approach allowed us to develop a streamlined and cost-efficient model capable of accurately assessing soil deficiencies.

Water and NPK emerged as the two primary factors to which we narrowed our focus, as addressing these elements is critical to our overall objectives. By concentrating on these specific aspects, we aim to achieve targeted outcomes and deliver impactful results in our precision agriculture endeavour.

The connections given are as follows:

NPK- RS485(A)-MAX485(A)

RS485(B)-MAX485(B)

+VE - 12V+ve

-VE - 12V-ve

MAX485- rx-pico(RX)

tx-pico(TX)

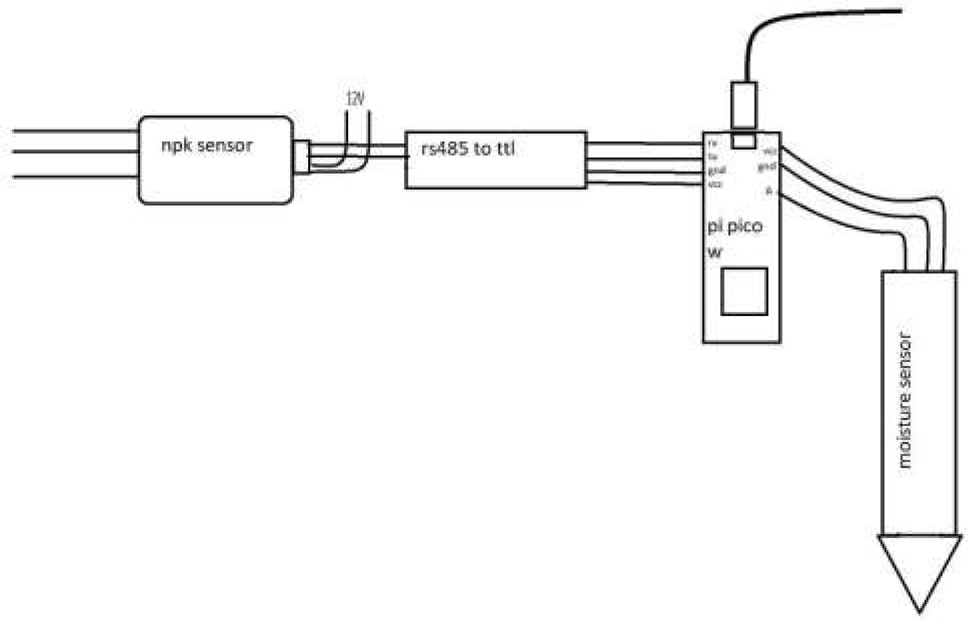
gnd-pico(GND)

vcc-pico(VCC)

MOISTURE- gnd-pico(GND)

vcc-pico(VCC)

A-pico(GPIO)



REPRESENTATION OF THE MODEL

These are the steps followed foe the implementation of the model.

Step 1: Deployment

Strategically place sensors at specific intervals throughout the field.

Step 2: Data Collection

Power on the sensors to initiate data collection.

Step 3: Data Transmission

Sensors send the collected data to a centralized database.

Step 4: ML Model Analysis

Utilize a Machine Learning model to compare the collected data with ideal crop conditions.

Step 5: Smart Recommendations

Based on the ML analysis, the system suggests solutions to maintain soil conditions as close to ideal as possible.

Step 6: Implementation

Implement the recommended solutions to optimize farming practices.

The proposed system leverages machine learning (ML) algorithms to analyse the real-time soil data and make crop recommendations based on the specific soil conditions. The ML model takes into account the NPK levels, moisture content, and other relevant environmental factors to provide accurate and personalized crop suggestions.

The crop recommendation system not only assists farmers in optimizing crop selection but also contributes to sustainable agriculture practices by promoting informed decision-making based on precise soil data. By employing real-time data collection and ML-driven recommendations, this project aims to enhance agricultural productivity and resource management, ultimately leading to better yields and improved farming practices.

RESULTS

Real-time Data Collection: Raspberry Pi Pico W successfully collected NPK and soil moisture values from the soil sensors, enabling continuous monitoring of soil conditions.

Data Transmission and Management: The cloud-based API efficiently transferred the data from Raspberry Pi Pico W to the database, ensuring secure and centralized data storage.

ML-Driven Crop Yield Prediction: The ML models, trained on historical data and considering soil conditions, accurately predicted crop yields based on the NPK and moisture values.

Smart Data Visualization: The Blynk app provided a user-friendly interface for farmers to access real-time soil parameter values and crop yield predictions from their smartphones or tablets.

Sensor Housing Unit: The developed housing unit effectively protected the sensors, ensuring their reliable performance in various environmental conditions.

CONCLUSION

In order to precisely calibrate agricultural practices, precision agriculture is a cutting-edge farming paradigm that makes use of modern technologies and data-driven approaches. It actively encourages sustainable farming practices while methodically improving operational effectiveness, crop yields, and quality. Processes for making decisions based on data, the seamless integration of artificial intelligence (AI) capabilities, and significant environmental benefits are all significant advantages. Despite the difficulties, the unrelenting expansion of technology guarantees a bright and exciting future for agriculture, one that is ready for constant improvement.

FUTURE DEVELOPMENTS

For future developments to the project we would like to implement an artificial intelligence (AI) model that would help analyse the ideal conditions of a lab model and test the real conditions on the given farm and the ai will run and predict the most accurate and close to optimal values such as (NPK, water, etc) to be put to match the lab model. We are shifting our focus towards the fertility of the soil which is the problem in today's current condition which also directly affects the yield of the crop, the future development for this project would be to get the ai model to be very accurate to the ideal conditions and secondly we want to work on the development of a housing unit that would help hold the given sensors. And thirdly we would like to work on an interface that would help the farmer understand the readings in a very simple and direct approach (maybe a visual or audio message).

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