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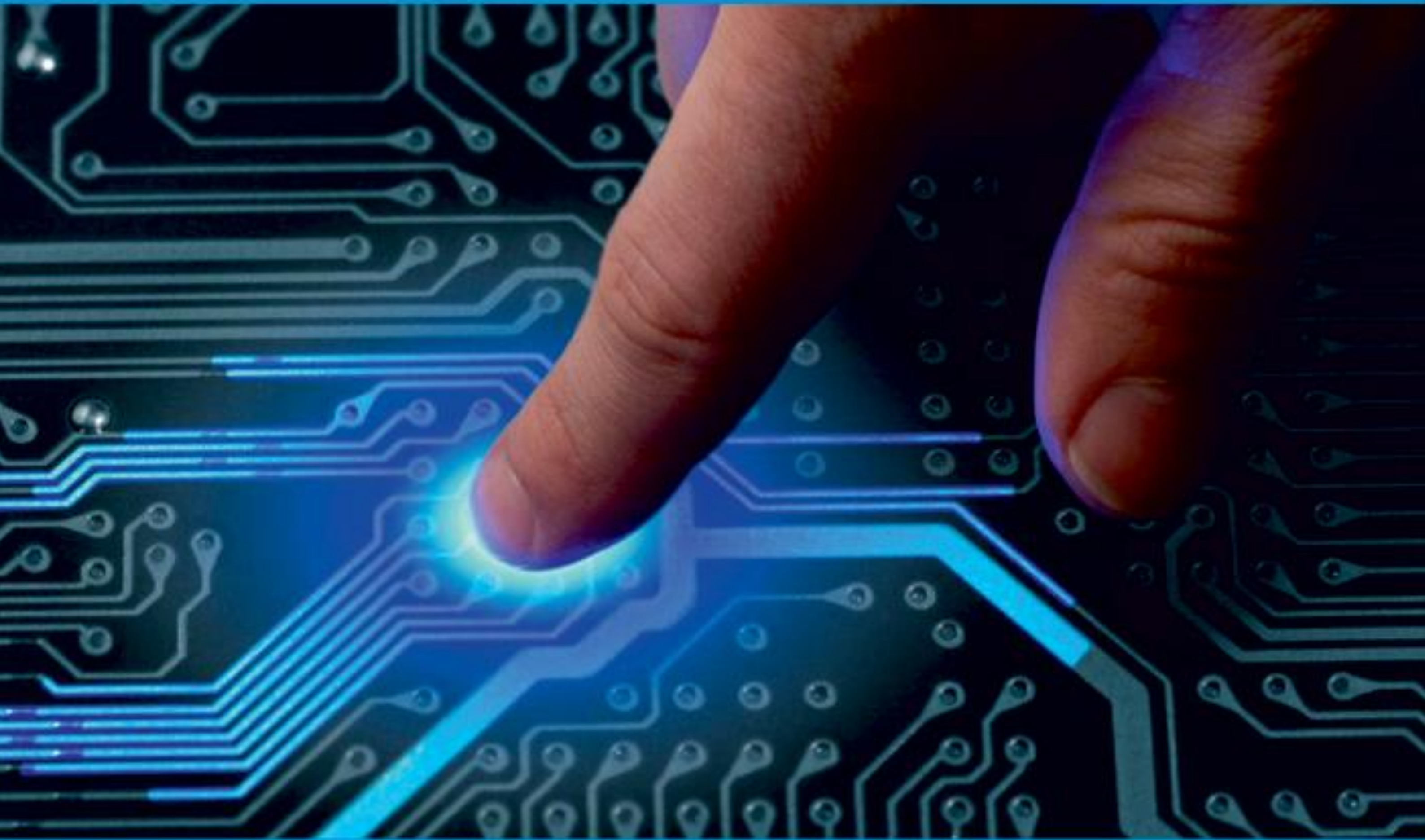

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IoT and ML Based Crop Recommendation System

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ABSTRACT: The aim of this project is to develop a system that uses the Internet of Things (IoT) and machine learning (ML) to help farmers select the best crops for their fields. The geolocations are fetched using the GPS receiver by communicating with the satellite. The system consists of IoT sensors that collect data on soil and environmental conditions, such as pH, temperature, humidity, and rainfall. This data is sent to a cloud platform, where ML algorithms analyze it and provide crop recommendations based on historical data, weather forecasts, and soil properties. The system offers a user-friendly interface that allows farmers to access the recommendations, monitor their crops, and provide feedback. The system aims to enhance agricultural productivity, resource efficiency, and sustainability by using data-driven insights.

KEYWORDS: Agriculture, Precision Agriculture, Kaggle website, KNN Algorithm, IoT, Machine Learning.

I. INTRODUCTION

Agriculture is a vital sector for the global economy and food security, but it faces many challenges such as climate change, resource scarcity, and population growth. To overcome these challenges, farmers need to adopt smart and sustainable farming practices that can optimize crop production and resource efficiency. One of the promising ways to achieve this is by using the Internet of Things (IoT) and machine learning (ML) technologies to develop a crop recommendation system that can help farmers make informed decisions about what crops to grow and how to manage them. A crop recommendation system is a system that uses data from various sources, such as sensors, satellites, weather stations, and historical records, to provide customized suggestions for crop selection and management. The system can leverage the power of IoT and ML to collect, process, and analyze large amounts of data in real-time and generate insights that can improve agricultural productivity and sustainability.

The ultimate goal of crop recommendation systems is to increase yields, reduce waste, and improve the overall sustainability of agriculture. By providing farmers with accurate and timely recommendations based on real-time data, these systems can help them make. Overall, crop recommendation using IoT and machine learning is an exciting area of research with the potential to revolutionize the way we approach agriculture.

By combining the power of data analytics, automation, and agricultural knowledge, we can work towards a more sustainable and efficient future for farming. Informed decisions and optimize their resources. Moreover, these systems can also help to reduce the environmental impact of agriculture by minimizing the use of fertilizers and pesticides, and reducing water waste.

II. RELATED WORK

In this literature review of this project, the team sought out and studied various research papers, documents, and newspapers and magazine articles from various scenes. The paper [1] states requirements and why they tend to move into precision agriculture, which is due to globalization are discussed. Precision agriculture is site-specific farming. Though Precision agriculture has shown an improvement with time, there exist some issues. As mentioned above site-specific methods of such systems are needed to be supervised to get an improved result. Only a few of the outcomes are provided a particular result. The paper presents a crop recommendation system that uses IoT sensors, machine learning algorithms, and natural language processing to help farmers choose the best crops for their fields. In paper [2] numerous research has been performed in this area, which includes weather and soil data for suitable crop identification and crop yield prediction. A stochastic seasonal weather forecasting model ,which is integrated with crop simulation model to predict expected yield and economic return. It also uses probability distribution function to shows the reliability of prediction for a particular region. A soil classification method is presented by Paul et ,which classifies soil into three categories: low, medium and high based upon its nutrient content . Soil parameters such as pH, organic carbon, nitrogen, phosphorus, potassium and some other micro-nutrients are used for classification using KNN. The class of soil helps in identifying suitable crops for soil that gives maximum yield. The paper proposes a method to help farmers select the best crops for their fields based on weather and soil data. The method uses machine learning algorithms to predict weather conditions and suggest suitable crops. In [3] researchers have compiled a comprehensive dataset by augmenting existing datasets on rainfall, climate, and fertilizer data in India. The dataset is utilized to develop a machine learning model that predicts the most suitable crops for specific locations. The dataset comprises 2200 values of 22 unique crops from **Kaggle**, and machine learning algorithms are applied to train and test the model's accuracy. Professor highlights the current lack of technology usage among farmers, leading to potential income reduction due to incorrect crop selection. The research aims to address real-world requirements and lay the groundwork for future enhancements, considering additional factors that impact crop selection in specific fields and locations. In [4] paper , we have effectively proposed and implemented an intelligent crop recommendation system, which can be easily used by farmers all over India. By using this research we can increase productivity of the country and produce profit out of such a technique. This investigation has expressed the recommendation of various crops of India using different machine learning algorithms like Decision Tree, Naïve Bayes, Support Vector Machine, Logistic Regression, Random Forest and XG-Boost.

Overall, these studies demonstrate the potential of crop recommendation using IoT and ML to improve crop yield, reduce input costs, and increase sustainability in agriculture. Further research in this field could lead to more efficient and sustainable crop management practices, benefiting farmers and the environment alike.

PROBLEM IDENTIFICATION

1. Inefficient Crop Compensation Process: Traditional crop compensation systems often involve lengthy paperwork and delays, leading to inefficiencies.
2. Inaccurate Assessment: Manual assessment of crop damages may result in inaccuracies, affecting fair compensation for farmers.
3. Limited Data Utilization: Existing systems may not leverage the potential of Machine Learning (ML) and Internet of Things (IoT) technologies for comprehensive data analysis.

III. PROPOSED ALGORITHM

KNN ALGORITHM

- KNN Algorithm is a Machine Learning Algorithm that is based on Supervised Machine Learning.
- It is used to train machines using labeled data.
- The model just needs to map the inputs with the outputs.
- In this project, the KNN Algorithm is used to classify the data and split the data into training and testing.
- It uses the Euclidean distance equation to classify the data and to find the nearest neighbor.
- In KNN Algorithm the K value must be always an odd number to classify the data. Because the result is based on a voting system.

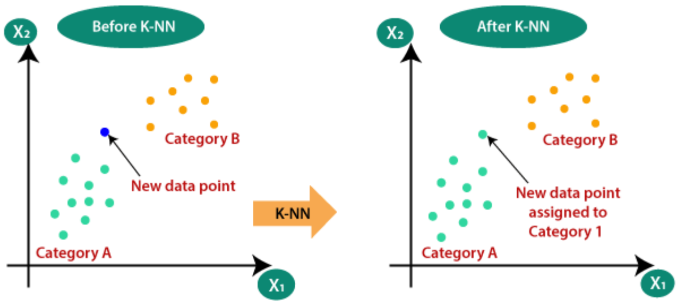

Fig 1: KNN Algorithm

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IV. FLOWCHART FOR TRAINING MODEL PROCESS

Data acquisition module: This module includes collection of data is used for training and testing process of ML model as sequence shown in fig 2.

GPS module

- Location is taken using GPS from an Android application.
- Co-ordinate values are sent to the rest soil grid website which returns the soil parameters of that particular location.
- Here we've taken one such soil parameter forexample board work calculations.

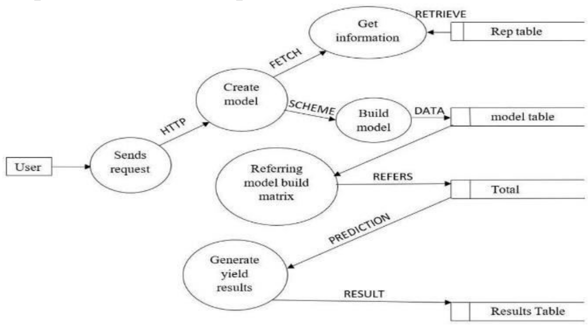

Fig 2: Design methodology of the proposed system

SYSTEM IMPLEMENTATION

In IoT module, ESP32 development board is used. It is associated with a GPS module, Push button, and LCD display. GPS module is used to fetch the geo-locations of the particular field and it invokes by pressing the push button. Then the request is sent to Flask Web Framework server which is connected to the Machine Learning Model. Datasets of different crops that include soil parameters like nitrogen, pH of soil, and weather parameters like temperature and humidity are taken to train the ML model. The model includes the KNN algorithm which uses Euclidean distance based on K value creates the matrix then will build the voting model and will select the highest voted crop. Then the recommended crop is displayed on the LCD display.

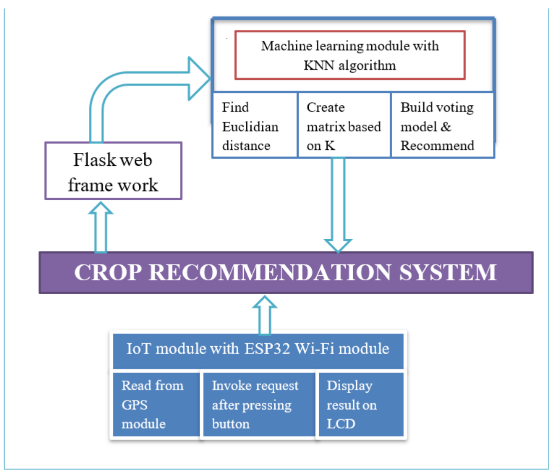

Fig 3. Block diagram of the proposed project

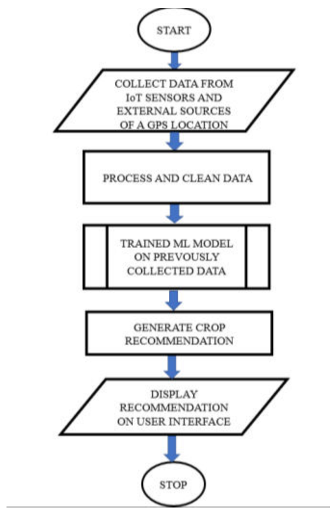

Fig 4 : Working of the proposed system

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CIRCUIT DIAGRAM

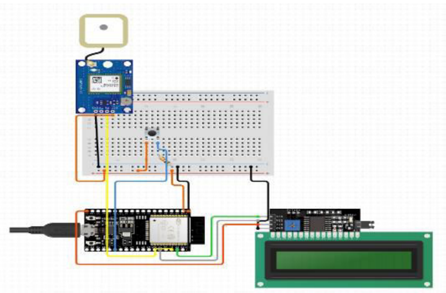


Fig 5. Circuit diagram of the proposed project

ESP32	I2C LCD Display
Vcc	Vcc
GPIO22	SCL
GPIO21	SDA
GND	GND

ESP32	GPS MODULE
Vcc	Vcc
TXD0	TX
RXD0	RX
GND	GND

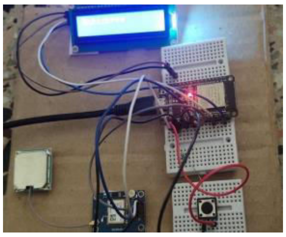
Table 1. Pin configurations of circuit diagram

V. RESULTS & DISCUSSIONS

The proposed project is to help farmers in choosing the correct and appropriate crops. Did this project by taking 2200 datasets of different crops that include soil parameters like nitrogen, phosphorus, pH of soil, and weather parameters like temperature and humidity. Taken 1700 for training and 500 datasets for testing. By considering these parameters will find crops by applying the KNN algorithm. The project, can achieve good efficiency. The prototype of proposed system is as shown in fig 6.

After pressing the push button the geometric parameters are read from the GPS module, then it invokes a request. Then the request is sent to a Flask web framework server which is connected to the machine learning model and shows message as in fig 7.

After completing the machine learning process, it will predict an appropriate and suitable crop and it will be displayed LCD display. If the GPS fetched place is not a village then that data has been masked by the server and model shows the message as "go 2 village" as shown in fig 8. If the GPS fetched place is a farmland then the data from the server is used and predict crop nameas shown in fig 9.



a) Prototype

b) Crop recommendation system

Fig 6. Model of the proposed project

Fig 7. Device connected tothe server

Fig 8. Message given by model

Fig 9. Prediction of crops by proposed model for different regions

VI. CONCLUSION AND FUTURE WORK

In conclusion, crop recommendation using IoT and machine learning has great potential torevolutionize the agricultural industry by optimizing resource utilization, reducing input costs, and increasing crop yields while maintaining sustainability. By integrating data from IoT sensors, such as soil moisture and temperature sensors, with machine learning algorithms, crop recommendation systems can provide farmers with real-time information on crop health and environmental conditions, enabling them to make informed decisions about crop management practices.
However, there are still challenges to be addressed in the implementation of these systems, such as the need for reliable and secure IoT infrastructure, the high cost of sensors and data storage, and the need for effective data analysis and interpretation. Nevertheless, ongoing research and development in this field hold promise for the future of agriculture, enabling farmers to make better use of resources, improve crop quality, and ultimately increase food production to feed a growing global population.

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