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Precision Agriculture Using Artificial Intelligence & Machine Learning Techniques

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Abstract— Many sensors have emerged for different applications nevertheless only rare of the sensor are in use for agriculture field to identify soil type and nutrients specifications this provides a vast space in research. Numerous agricultural research centers are developed and are still on work as an equipped lab for monitoring these data for farmer's necessity. Getting soil from farmers processing in the lab and resulting in the required data is a common feature but realistic field monitoring sensors are a challenging task. This framework is to develop an easy man - handle sensor for identifying parameters such as: type of the soil, water scarcity, amount of nutrient present in the soil, type of seed for plantation, fertilizer required for the growth of crop, type of diseases that may infect, crop harvesting and cost estimation after cultivation. Classification of these substantial parameters are made using machine learning techniques and to correlate each parameter with its corresponding attributes to provide continuous field monitoring effective precision agriculture is the proposal work. This work focuses on all the parameter fixed together to a sensor listing out the production and cost estimation of any field.

Keywords—Machine learning, Soil nutrients, Deep learning, Fertilizers.

I. INTRODUCTION

In early days people especially farmers had complete knowledge about agriculture field in the form of, the type of crop that can be seeded, the period of crop harvesting, prediction of weather forecasting, type of natural fertilizers that can be accommodated for plantation, water scarcity and many relational dependencies for agricultural growth. These related parameters are made to be possible with sight-seeing of experienced farmers. On the growth of a generation, these involvements and observations of field farming started to get diminished little by little. Enriching these parameters growth on the field and analyzing them by certain experience are called Field Monitoring. In order to produce better crop cultivation farmers segregated on the base of districts just as Rice – Tanjore, Coconut-Coimbatore, Maize-Tirupur and so on. A major source of agriculture is fertilizers and nutrients percent present in the soil. This percentage was very huge in the early time period due to land degradations and natural causes little by little the stage of agriculture and farming started to reduce in crop cultivation. By default, many districts in Tamil Nadu have also lost its label in producing their land makeable goods. Field Monitoring has come to a crucial stage. The role of this work is to support agriculture growth by means of field monitoring. So that crop production leads to huge growth in both production and trade comparing to other countries. Many authors on this field have reviewed with a summarization of reports. Few have product based developments on field machinery. The start of this work is to produce an application-oriented network among farmers to increase more on farming. It involves two major domains: Data Science combines various fields of work on statistics and computation in order to interpret data for the purpose of decision making, it plays a vital role in analyzing data according to field monitoring and also examines the parameter that belongs to specific field crop. Machine Learning focuses on the growth of computer programs that can access data and use it learn for themselves, itmaps the related field parameters among each other to produce flavored results. ML also has many algorithms that can assist to relate with field parameters and to its specific attributes. In brief of involvement of these two domains and various surveys are discussed much more in detail for further chapters.

II. OBJECTIVE

Generally, with the availability of the nutrients present in the soil sowing of the seed and plant growth is farmed. If the farmer is in need of getting an option of planting different varieties of plantation in the field then an additional percent of nutrient is to be known, in order to determine the growth of any plant at any type of soil with any source of nutrients available or even to be added is the main purpose of this research. This makes the field of agriculture to a massive change in production and trade.

III. LITERATURE SURVEYS

A. Reviews of Sensors on Soil Nutrients Identification

The way to increase the crop fertilizers nutrients N (nitrogen), K (potassium) and P (phosphorus) as the same measuring out extra contents of above nutrients to get added in the soil for yielding good fertility using optical fiber sensor. Colorimetric measures for an aqueous solution in the soil are occupied through the absorption of colors. It determines the Sodium, Potassium, Phosphorus levels are high, medium, low, or none. Through signal conditioning circuits and sensor probe detection of component deficiency of the soil is determined. It is beneficial in providing only the essential quantity of fertilizers in the soil.

B. Reviews on Soil Nutrients Management and Monitoring

Soil nutrient monitoring meditation by M.H.A. Husni et.al. Suggested low-cost measurements using higher density. A simplified variable-rate nutrient is obtained from an effective mapping of nutrient variability. In order to maintain crop productivity and cost-effectiveness nutrient management by means of sensor technology potentially encourages to a large extent. Sensors like optical, Electromagnetic and electrochemical sensors helped out a lot in non – destructive quantification for spatially – variable in soil nutrients. Visual observation can outcome in a flawed diagnosis that ultimately dislocates remedial action for the artificial plant/crop. Supernatural reflectance dimensions can help to identify and select wavelengths sensitive to single plant stress. Preceding studies have found that plant stress will variate spectral reflectance design in the visible range (380-720 nm or F380-F720) and the infrared range (720-1500 nm or F720-F1500). Classically, the magnitude modification will vary at dissimilar wavelengths. Such information enables premature detection of plant stress, mostly nutrient deficiency. This method can possibly provide lower operating cost in fertilization and minimizes acute loss of productivity.

C. Reviews on Deep Learning in the Field of Smart Agriculture

Provides a summary of Deep Learning algorithms that includes the concepts, restriction, execution, training procedures, and sample codes, to assist researchers in agriculture. Deep Learning applications in agriculture are concise and analyzed as per Nanyang Zhu. Et.al suggestions Machine learning techniques have created probabilities for data-intensive science in the multi-disciplinary agricultural machinery domain. The author categorized them under crop management, holding applications on yield prediction, disease detection, weed detection, crop quality, and species recognition; livestock management, including applications on animal welfare and livestock production; (c) water management; and (d) soil management. Filtering and classification on this bid for agriculture will benefit from machine learning technologies to sensor data, farm management systems are developing into real-time artificial intelligence enabled programs that deliver rich recommendations and insights for farmer decision support and action.

IV. PROPOSED FRAMEWORK

The WET – 2 sensor produces the percent of nutrients and water scarcity available. The essence of this sensor it has a crucial role in precision horticulture, soil science research and is usable in both soils and growing substrates. It is not necessary for its ability to measure pore water conductivity (ECp), the EC of the water that is available to the plant. The sensor is easily given into substrates, composts and most soils. It takes less than 5 seconds to measure water content (%), pore water conductivity (ECp) and temperature. This analysis supports in segregating the parameters to frame its corresponding attributes for the available content of nutrients in the soil and also helps to know the additional favors of a nutrient percent to grow varieties of plant. Correlating these data with the database of seeds available one can determine the duration of the plant and can predict the maximum amount of crop harvesting. Data Science is to segregate the field based parameters into different levels of attributes ex. Soil nutrients act as a parameter which can hold Nitrogen (N), Phosphorus (P) and Potassium (K) as the essential growth of the plant in soil. Calcium (Cl), Magnesium (Mg) and Sulfur (S) as attributes. Similarly, other parameters can also be segregated into attributes according to the field representation. Deep Learning correlates these attributes and maps to its respective inter parameters like the percent of Potassium (K) in soil determines the type of seed and growth of plantation.

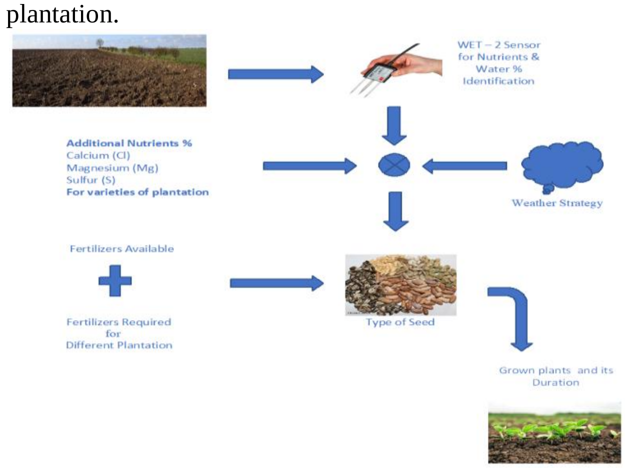

Figure 1: Proposed Architecture Framework

V. PROPOSED ALGORITHMS

A. *Working Principles of WET 2(Water content Electrical conductivity Temperature) sensor*

The measured value of dielectric properties is converted into Water Content up to the range, 0 – 80%, by means of calibration tables. Most common soil types and specialized calibrations are accessible as distinct cost options for a number of artificial substrates. This calculates Pore Water Conductivity, the Electrical Conductivity of the water inside the pores of the soil (ECp). Its calculation is grounded on a single formula that diminishes the properties of probe contact and soil moisture on the readings. Temperature is restrained using a miniature sensor made into the central rod. This produces a measurement of nutrients percent available in the soil.

B. *Working principles of nutrients correlation*

According to the base of available nutrients, the additional percentage of required nutrients is correlated with the data related to weather forecast are mapped using Principal Component Analysis (PCA). This PCA is calculated by the following stages,

1. Normalization of data.
2. Calculation of covariance matrix.
3. Calculate eigen values and eigenvectors.
4. Choosing components and forming a feature vector.

C. *Working principles of prediction analysis*

Nutrients and fertilizers availability helps in providing a comparison of plant growth duration mapping with the type of seeds to be sowed. This process of analysis is done by Navie Bayes algorithm which is very familiar in predicting the attributes that do not interact. The Navie Bayes holds two probabilities Class determines the frequency of instances belongs to each class divided by the total number of instances. And Conditional represents the frequency of each attribute value of given class value divided by the frequency of instances with that class value. To the initial Bayes theorem is given by,

$$P(y|X) = \frac{P(X|y)P(y)}{P(X)}$$

Here, X = 1,2…..n represents the features, i.e they can be mapped to outlook, temperature, humidity and windy

According to the values in data set the conditional probability looks like,

$$P(x_i|y) = \frac{1}{\sqrt{2\pi\sigma_y^2}} exp\left(-\frac{(x_i-\mu_y)^2}{2\sigma_y^2}\right)$$

Navie Bayes is stated in the following step based approach:

1. Collect Data
2. Summarize Data
3. Make Predictions
4. Evaluate Accuracy
5. Tie it together

VI. CONCLUSION

The purpose of this research on field monitoring through data science analysis and machine learning has an impact. Even though many algorithms and implementations on agriculture are emerging only a fewhave givena complete attraction and usage. This work focused on analyzing the farming data. Collection of soil type, fertilizer requirements, type of seed are certain huge databases involved with certain complications. Machine Learning organized these data through algorithms to a perfect structure. Implementing these data through algorithmic portfolio using Machine Learning techniques is very common but to the implementation, tothe plantation is a challenging task. This work found a source to develop precision agriculture that directly or indirectly leads to a growth of the nation. This field can grow further by implementing better Machine Learning algorithms as of new algorithms emerge by every time.

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Mr. K.R. Radhakrishnan has completed Master of engineering in Anna University, Chennai. He is currently working in KCG College of technology Chennai, with five years of teaching experience. He has undergone research in medical image processing and currently working in machine learning with various application. He has guided many students in research.

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