IoT Technology for Fertilizer Recommendation using Naïve Bayes Classification to Increase Coconut Yield

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Abstract— Fertilizer recommendation to most agricultural crops is based on response curves. Such curves are constructed from field experimental data, obtained for a particular condition and may not be reliable to be applied to other regions. Fertilizer Recommendation System for Coconut Crop based on the water consistency will provide a more coconut yield. This paper is fully focused on coconut yield using data analytics method. The System considers the expected productivity and plant nutrient use efficiency to estimate nutrient demand, and effective rooting layer, soil nutrient availability, as well as any other nutrient input to estimate the nutrient supply. For producing more coconut, we propose a naive bayes algorithm to analyse the activity of the coconut to produce more quantity. The data set for the development of the System for coconut trees was obtained from IOT based dataset. Dataset were collected and generate the result to produce the high yield of coconut. We also prove the accuracy level for analysing the coconut and minimize the time level.

Key words: IoT, Agriculture Data, Coconut, Naïve Bayes & Increase Production

I. Introduction

In the farming, field crop needs management of pesticides, fertilizers, and irrigation for better growth, precision agriculture (PA) is the concept used for the same purpose. The information such as temperature, humidity, fertilizer, and soil moisture can be provided as input by PA to decision support system for maximizing the crop growth with the optimized use of available resources and without affecting an environment. Agriculture plays a vital role in country's economy and it has a extensive contribution towards human civilization. Due to the growing expansions in sensor devices, Intelligent Systems and Internet protocols the architecture of IoT has been made to support agriculture by making a Smart agriculture [1]. IoT is involved in various agricultural activities. Each smart system uses different techniques and IoT serves as the central part of all the smart works. It includes sensor devices, protocols, satellite imaging, drones and gateways which are all connected to cloud servers. Each developed system captures its down data's such as soil moisture, temperature, humidity, pH level, oxygen requirements are collected and appropriate decisions are taken. Still the system is enhanced by totally automating the agriculture thereby increasing the economy of country [2]. The Internet of Things (IoT) has the capability to transform the world we live in; more-efficient industries, connected cars, and smarter cities are all components of the IoT equation. However, the application of technology like IoT in agriculture could have the greatest impact. Smart farming based on IoT technologies will enable growers and farmers to reduce waste and enhance productivity ranging from the quantity of fertilizer utilized to the number of journeys the farm vehicles have made. In terms of environmental issues, IoT-based smart farming can provide great benefits including more efficient water usage, or optimization of inputs and treatments [3]. Now, let's discuss the major applications of IoT-based smart farming that are revolutionizing agriculture. Improving farm productivity is essential for increasing farm profitability and meeting the rapidly growing demand for food that is fuelled by rapid population growth across the world. Farm productivity can be increased by understanding and forecasting crop performance in a variety of environmental conditions [4]. For coconut trees, the fertilization regime is divided in three stages: fertilization at the planting spot, band fertilization and fertilization at the production phase. The data set for the development of the System for coconut trees was obtained from the literature. The recommendations generated by the System were compared to those derived from recommendation tables used for coconut crop [5]. Crop recommendation is currently based on data collected in field-based agricultural studies that capture crop performance under a variety of conditions (e.g., soil quality and environmental conditions). This paper explores the prospective of Internet of Things (IOT) in the area of agriculture, aspired at the coconut tree cultivation. Smart agriculture replaces the traditional mechanism.

II. Literature review

Sap MN [6], for predicting production of rice crop, an intelligent tool is developed with the help of machine learning approach. This tool is used in classification and clustering. Rice plantation data are classified using Support vector machine learning technique. Kernel-based clustering algorithm is used for finding cluster in climate data. To manipulate complex, high dimensional and non-linearly separable data Kernelbased methods are applicable. The impacts of various influencing parameters on the rice yield are evaluated using correlation analysis and using regression analysis prediction about crop yield rate is done. Support vector machine is used for noisy data. Due to all these features technique from this paper used as an intelligent system for predicting rice yield.

K.Spandana [7], analyze the concept of Smart Agriculture is becoming a reality as it evolves from conceptual models for the development of crop at different stages. Previously the agriculture is the cultivation of the plants which is used to sustain and enhance human life. Now a day the Smart Agriculture has come into the picture globally. Smart Agriculture is nothing but the usage of the resources in a smarter way. Resources include sustainable land usage, fresh water usage, and usage of pesticides and insecticides which increases the crop production and supports the farmers' income. Firstly the developed Sensor kit will be checking the Soil type and Soil Quality. Later the different tests are performed on soil such as bulk density test, respiration test, moisture test and it also needs to check the water quality. By considering the results obtained by the above tests the device suggests the crop for the farmer and it also helps him for the maintenance of the crop. To keep the services of Smart Agriculture the IOT plays a key role.

Dahikar SS [8], To select the crop and to predict production rate of the crop artificial neural network use information collected by sensors from the farm. This information includes parameters such as soil, temperature, pressure, rainfall, and humidity. The effect of these parameters on crop growth is discussed, and results are evaluated in paper. It is observed that the atmospheric parameter, soil type, and soil composition can impact on production rate of crop. The technique discussed in this paper also predicts suitable crop production rate in advance. Artificial neural network is used as effective tool for modeling and prediction of crop production rate and improves the accuracy of crop prediction.

A. Srilakshmi [9] Agriculture plays a vital role in country's economy and it has an extensive contribution towards human civilization. Due to the growing expansions in sensor devices, RFID and Internet protocols the architecture of Internet of Things (IoT) has been made to support agriculture by making a Smart agriculture. This paper describes the implementation of various IoT techniques and intelligent decision support systems used in agriculture. It provides a wide review on methods and technologies like ANFIS and PLSR Model predictions, experiences in various challenges as well as further work are discussed through the review article.

Gustavo Nogueira Guedes Pereira Rosa [10] Fertilizer recommendation to most agricultural crops is based on response curves. Such curves are constructed from field experimental data, obtained for a particular condition and may not be reliable to be applied to other regions. The System considers the expected productivity and plant nutrient use efficiency to estimate nutrient demand, and effective rooting layer, soil nutrient availability, as well as any other nutrient input to estimate the nutrient supply. Comparing the nutrient demand with the nutrient supply the System defines the nutrient balance. If the balance for a given nutrient is negative, lime and, or, fertilization is recommended. On the other hand, if the balance is positive, no lime or fertilizer is needed. For coconut trees, the fertilization regime is divided in three stages: fertilization at the planting spot, band fertilization and fertilization at the production phase. The data set for the development of the System for coconut trees was obtained from the literature.

III. Problem Definition

In existing paper explores the prospective of Internet of Things (IOT) in the area of agriculture, aspired at the coconut tree cultivation. Smart agriculture replaces the traditional mechanism. In existing paper multi model data collection system is proposed [11]. Thus the IOT based smart agriculture in the coconut tree cultivation reduces the time and cost needed for the soil testing. It also gives periodical monitoring about the soil health. It will be very helpful for the agriculture community. Thereby the outcome of the paper will be supportive for effective agricultural practice in cultivation of coconut tree. The Problems faces in existing work are crop management, agricultural security, animal husbandry, food safety, water, waste management etc. low production of coconut. Waste of time to analyze the water level in old method.

IV. Proposed Method

This paper is fully focused on coconut yield using data analytics method. The System considers the expected productivity and plant nutrient use efficiency to estimate nutrient demand, and effective rooting layer, soil nutrient availability, as well as any other nutrient input to estimate the nutrient supply. For producing more coconut, we propose a naive bayes algorithm to analyse the activity of the coconut to produce more quantity. It collects multiple environmental data such as macro-nutrients (Nitrogen (N), Potassium (P) and Phosphorus (K)), pH value and moisture level of the soil with the help of wireless sensor motes. Once motes collect the information from the soil, it transmits its data to the data collection centre with the help of energy efficient data forwarding algorithm. The data set for the development of the System for coconut trees was obtained from IOT based dataset. Dataset were collected and generate the result to produce the high yield of coconut. We also prove the accuracy level for analysing the coconut and minimize the time level. IOT can help in choosing such inter-crops by monitoring the soil water level and the conditions. Advanced farming techniques can be used for the growth of such crops. IoT in coconut farming can also be extended to monitoring the crop storage, geo-tracking the coconut shipments etc. Smart coconut plantations can really help automating irrigation and other manual process to a large extent.

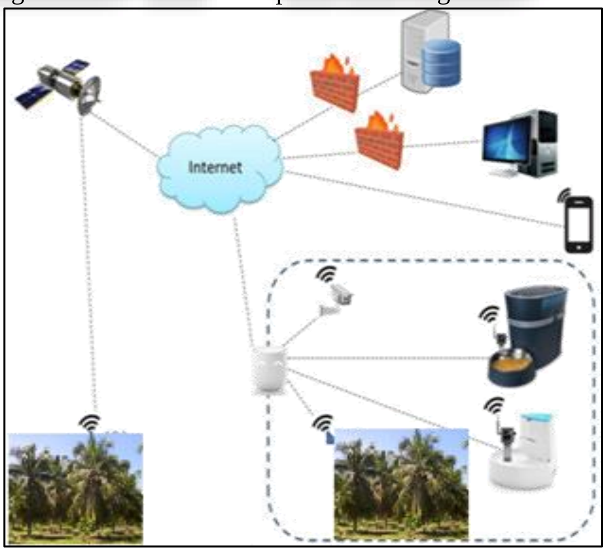

Fig. 1: Proposed Architecture

It provides an accurate result of coconut yield. It stores the data in database using IOT technology. It stores the data at any time in IOT device so it can lead a chance t find out the crops yield. It reduces data for strength conservation. Here routing the information with the help of energy efficient data forwarding algorithm [12]. Suggest the required proportion of the fertilizers to the end user.

A. Moisture Sensor

Generally two methods are used for measuring the moisture level availability in the soil such as soil moisture tension and soil moisture content. Soil moisture tension expresses the ability of the soil in extracting water. Soil moisture content describes the ease of use of the water in the soil. It is usually referred in terms of percentage. In this paper, moisture sensor is used for measuring the water content availability in the soil. For which 10HS large moisture sensor (figure 3.4) is used. It operates at 12 to 15 mA. The 10HS measures approximately 1.3 litre area of influence using frequency domain technology. The output voltage of 10HS sensor is 300 to 1250 mV. For calibrating the moisture sensor, water level is measured from various places with the help of 10HS sensor. Based on the the test results shown in table 4.2, moisture sensor is calibrated [13].

B. Analyzing the Production using Naive Bayes Classifier

Capturing the large volume of heterogeneous data produced by a variety of IoT sensors (and possibly manual measurements), and doing this for a large number and variety of activities involving different studies as well as crops. Integrating heterogeneous data from such a great variety of IoT devices and also historical crop performance data produced by past. Naive Bayes classifier is probabilistic classifier. It predicts the class according to membership probability [14]. To derive conditional probability, it analyzes the relation between independent and dependent variable. Where, X is the data record and H is hypothesis which represents data X and belongs to class C. Construction of Naive Bayes is easy without any complicated iterative parameter. It may be applied to large number of data points but time complexity increases. Naive Bayesian classifier algorithm is used to generate models with extrapolative capabilities. It afford new ways of discover and considerate data. The Naive Bayesian classifier or simple Bayesian classifiers statistical classifiers and talented to forecast class association likelihood such as the likelihood that a given tuple fit in to a fastidious class. Bayesian classification is based on Bayes' theorem. The Naive Bayes Classifier method is chiefly suitable when the dimensionality of the inputs is high [14]. The likelihood which are applied in the Naïve Bayes algorithm are calculated according to the Bayes Rule, the likelihood of hypothesis H can be designed on the basis of the hypothesis H and evidence about the hypothesis E according to the following formula:

$$P(H/E) = \frac{P(E/H) * P(H)}{P(E)}$$

With the help of this formula it can calculates the values and it allows one to choose the kernel estimator for numeric characteristic rather than a normal sharing and used Supervised Discretization while exchanging numeric characteristic to normal ones. The output of Naïve Bayes classifier has text form. Naïve Bayes Classifier is that it supposes that all characteristic are self-determining with each other whereas in medical domain characteristic such as patient symptoms and their physical condition state are connected with each other. In spite of supposition of quality independence, Naïve Bayesian classifier has exposed great presentation in terms of rightness so if attributes are self-determining with each other then we can use it in medical field. With the assist of this method it guess the result accurately in the text form, it meet the expense of an enhanced result for a very large quantity of records [15].

Yield of the crop mainly depends on the macro and micro nutrients of the soil. Macro nutrients of the coconut are Nitrogen (N), Phosphorus (P), Potassium (K), Boron (B), Manganese (Mn), and Magnesium (Mg).Micro nutrients of the coconut are Sulphur (S), Iron(I), Zinc (Z), Calcium (C) and Copper. This paper mainly focus on macro nutrients such as N, P, K, pH and moisture level of the soil. Nitrogen is very important for rapid development and growth of the coconut tree. Nitrogen promotes the development of the vegetative parts of the plants especially the leaves and shoots. By providing phosphoric acid and potash, complete effect of nitrogen in plant metabolism could be achieved. In coconut, it plays an essential role in development and additionally to build the quantity of leaves and the fruit bunches. Lower leaves and yellowish colour leaves are symptoms for nitrogen deficiency [16].

V. EXPERIMENTAL RESULT

Our experimental result shows the coconut production with the help of these items. Yield of the crop mainly depends on the macro and micro nutrients of the soil. Macro nutrients of the coconut are Nitrogen (N), Phosphorus (P), Potassium (K), Boron (B), Manganese (Mn), and Magnesium (Mg).Micro nutrients of the coconut are Sulphur (S), Iron(I), Zinc (Z), Calcium (C) and Copper.

Experimentation is held for the coconut tree land situated at pollachi. For experimentation, 2000 Sq.m area is taken. As the communication range of the transceiver is 100 Sq.m, 20 motes are equally deployed to cover the entire sensing region. Once the data is collected from the field, motes transmit its data to the data collection centre with the help of energy efficient data forwarding algorithm for further analysis.

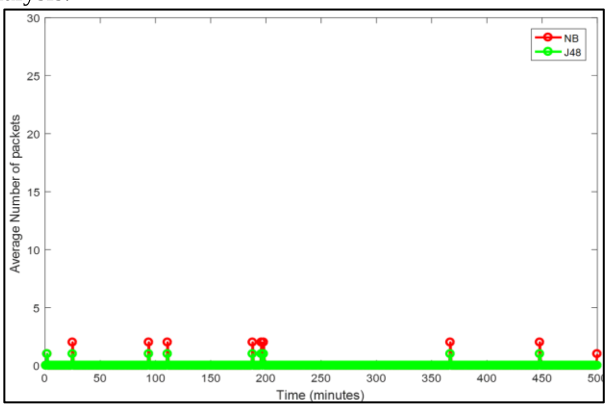

Fig. 2: Time Calculation

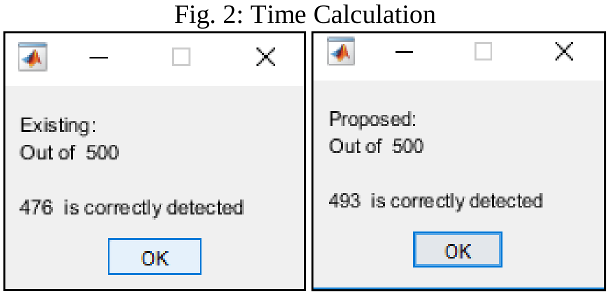

Fig. 3: Accuracy Calculation

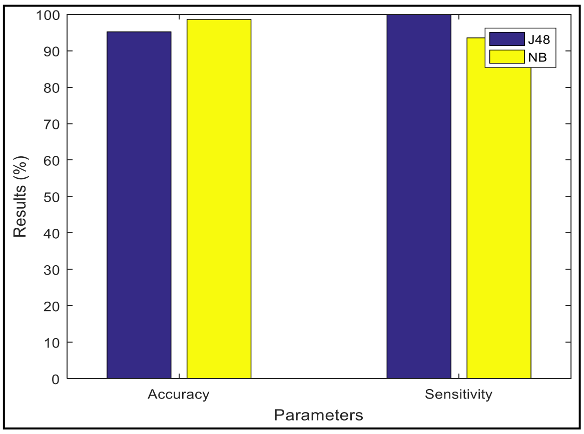

Fig. 4: Accuracy & Sensitivity

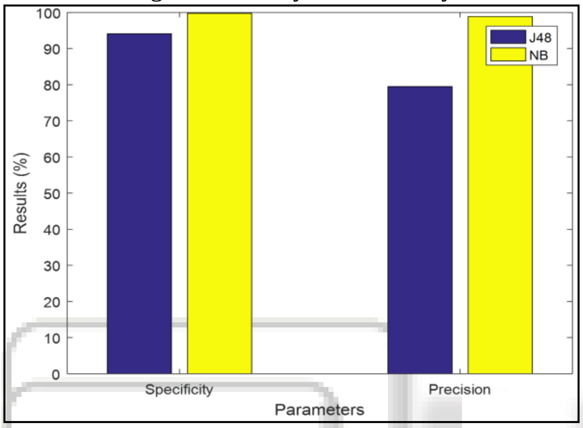

Fig. 5: Specificity & Precision

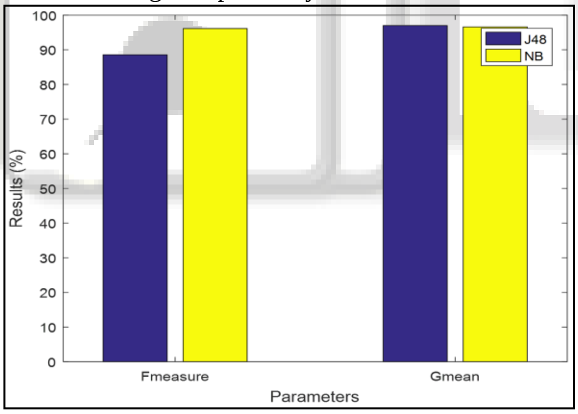

Fig. 6: Calculation of F-Measure & Gmean

A. *Performance of Existing*

- Accuracy: 95.2000
- Sensitivity: 100
- Specificity: 94.1032
- Precision: 79.4872
- Fmeasure: 88.5714
- Gmean: 97.0068

B. *Performance of Proposed*

- Accuracy: 98.6000
- Sensitivity: 93.5484
- Specificity: 99.7543
- Precision: 98.8636
- Fmeasure: 96.1326
- Gmean: 96.6015

VI. Conclusion

IOT is an Smart agricultural in recent trends. Due to the deployment of connected farms, it can be easy to detect disease on crop or virus spread over farm using prediction technique and farmer can separate such farm from others. This research provides a suitable environment for growing crops based on the IoT systems. It collects multiple environmental data such as macro-nutrients (Nitrogen (N), Potassium (P) and Phosphorus (K)), pH value and moisture level of the soil with the help of wireless sensor motes. We implement the concept of IOT in Coconut cultivation to bring the accurate quantity of production result by analyzing the water level of the soli with the help of the IOT device. And use the Naïve bayes algorithm to prove the accurate result for coconut production. We also prove the accuracy level for analysing the coconut and minimize the time level. IOT can help in choosing such inter-crops by monitoring the soil water level and the conditions.

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