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Assessment Framework Modeling using Location Aware Computing for Fertilizer Management and Crop Recommendation

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Abstract— Indian economy mainly depends on the agriculture, which contributes a major part in the growth and development of the nation. This is directly connected to the standard of life of farmers which covers more than 40 percent of the country population. Looking at the current situation of agriculture in India, agricultural productivity in India is not competitive to the world standards. For increasing the crop productivity farmers are forced to use more fertilizers which will end in health risk for the consumers. Lack of a proper knowledge of the effective usage of fertilizers and the changing soil nutrient values are the major problems for a farmer apart from the loss due to climate change and so many other factors. To address the problem , we propose to build an application model 'Prediction On Fertilizer Management for Crop Productivity' which enables the farmers to understand and effectively utilize their money with effective methods of seasonal crops production by providing recent and intimate information about which has to be produced, soil suitability, its nutrient values and soil moisture level which pasteurization management methods, how to apply the fertilizers in larger areas, what amount of water must be given, how to develop a model maps to the current scenario of farm areas. Crop Yield Production is basically an aggregation of crop and fertilizer recommendation, soil analysis, and crop yield calculations based on recent market scenario. Through our model we are revising and correcting the existing system with predictive analytics of the usage of effective fertilizers with less health risk.

Keywords—pasteurization; yield calculation; productivity; soil analysis; recommendation; aggregation

I. INTRODUCTION

A. LOCATION AWARE COMPUTING

Location plays a very crucial role in the designing of the context for ubiquitous computing, and many researches has evolved on location-sensing technologies. Studies are done on location aware computing and applications. When a user is able to describe his or her location textually or verbally to another user then location awareness is achieved.

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This can create anomalies, as communication in the form of descriptions or commands between users may be ambiguous, misinterpreted or misunderstood. User may not be keenly aware about the descriptions of their current location. Location-aware computing [3] avoids the confusions emerged from the references associated with verb and text based interaction.

Context-aware computing helps the user to sense their physical environment, and adapt their behavior accordingly. It is a general class of mobile systems. User's location and call arrival terminals are able to track by enabling the designed location management system. Based on the current speed and direction of movement of user, the size and shape of the location area of each single user's mobile terminal [2]. A distance based strategy will serve this purpose. Location update and paging are the operations commonly used for locating a mobile terminal in a networking environment.

A.Performance Metrics for Computing Context

- Network connectivity
- Communication cost
- User behavior or context

Context-awareness projects in Precision agriculture, helps to describe and evaluate the items of context used in the preprocessing stage such as cleansing the data.

Synthesizing our view of the literature examined, we find out three main classes of context items:

(i)User (ii) Environment and (iii) Activity

B. Characteristics for Location Context

- Distance
- Climate
- Size and Shape of location
- Time and Date

Designing the Location Aware [4] Computing follows the life cycle of context:

- Gathering and Capturing of contextual information is done in the initial stage of context discovery.
- Interpretation and selection of selective context from the captured Information.
- Information abstraction and utilization of the context.
- Building application and responsive measures using the contextual information.

These processes can be used to frame the model of the research in describing the context-aware lifecycle.

II. LITERATURE SURVEY

In India agricultural procedures proceeds using the traditional ways of recommendations for queries related to crop, pesticides and fertilizers.

Recommendations for farmers are based on one to one interaction by visiting their farms directly by the experts and conduct personal interaction and then recommendations are suggested in the modern scenario. Recommendation system can be generated using an application, for recommendation of the fertilizers and crops. The farmers may not be aware about the usage of a smart phone; a proper instruction set should be provided or should conduct awareness sessions for them. Industries are investing the ability of Android within other embedded platforms that require the ability to meet deadlines as a prerequisite for reliable operation [2][4]. The concentration of Nitrogen, Potassium and Phosphorous (NPK) values of the soil along with the water level determine the soil quality. A proper nutrient value to be determined by testing the soil based on the NPK and identify the extra nutrients to be added for fertilizer recommendation [3] to increase the crop yield [1][2]. The recommended fertilizer definitions are provided through social media accessible to the farmers. Along with the proper recommendation messages facilities are incorporated to purchase the nutrients from the site itself. Frequently purchased and searched fertilizers will be recommended to the user. The progress in the yield of the crops of the user's will be notified via officer [5]. The shopping process, bill and order details will be notified to the user.

The research by W. Fan, C. Chong, G. Xiaoling, Y. Hua and W. Juyun [6] is about predicting crop yield using big data analytics. The paper overcomes the failure of previous algorithm to handle massive data by using big data. The proposed system makes use of nearest neighbor along with Map Reduce for classification.The research by Z. Hong, Z. Kalbarczyk and R. K. Iyer [7] is about data driven methodology for developing precision agriculture (PA) solution. Machine learning model like Support Vector Machine (SVM) and Relevance Vector Machine (RVM) is used which makes prediction on soil moisture n days ahead.The research by M. Paul, S. K. Vishwakarma and A. Verma [8] is about prediction of crop yield by transforming into classification rule where naïve Bayes and K nearest neighbors methods are used.

The research by S. Dimitriadis and C. Goumopoulos [9] uses machine learning techniques which automatically extracts new knowledge in the form of decision rules. The result of the study is the creation of effective set of decision rules that are used to predict plant's state and prevent unpleasant impact of water stress in plants. The paper proposes the use of neural network and genetic algorithms in black box approach.The research by G. Yi-yang and R. Nan-ping [10] proposes the use of decision tree for classification. Clustering technique method is adopted to discretize the continuous data. Decision trees are the best suited because it transfers information into rules, it is crucial for decision.

The research by H. Li, Z. Chen, W. Wu, Z. Jiang, B. Liu and T. Hasi [11] proposes the use of data assimilation method which combines crop growth model with multi source observed This method is the most effective method to simulate crop growth process and predict crop yield.Arooj A et al. [12] have proposed the recommendation of crops based on the soil properties in different agricultural regions by applying various data mining techniques like Naïve Bayes and BF tree. The suggestion is that recommendation of crops leads to not only increase in yield but also reduced reliance on fertilizers.

Ponce-Guevara et al. [13] use a software to provide a predictive model for soil moisture. Big Data and Data Mining techniques applied on vegetable crops data help in analyzing the factors which influence crop growth in a greenhouse. These are the main factors that affect crop growth. For the purpose C4.5 is used and visually analyzed. Kulkarni et al. [14] propose a model which learns from historic soil and rainfall data to predict the yield of crops over seasons in several districts. The designed hybrid neural network model identifies patterns in that region to predict the crop yield. Time series model is applied for prediction with respect to rainfall.

III. PROPOSED TECHNICAL SOLUTION

A framework is developed to process and project the raw data which are strongly correlated with the attributes, public (pu) and private (pe). This focus on finding the regions which are safe [5] with respect to pu, but not pe. The attributes in an invert fashion preprocess the raw data and categories the prediction of crop yield.

The objective of the proposed research work is carried out with the following steps

- Study and Analyze the existing techniques
- Classify and summarize context aware systems
- Designing and developing conceptual framework for the integrations of location aware systems for agriculture pasteurization.
- Evaluating proposed mechanism with various performance metrics for health risk analysis.
- Comparing and proving that the proposed technique is efficient by deriving mathematical models

A. Algorithm for fertilization management FRET

Initially the FRET [5] framework finds the quality of the soil with the specific imparts and analyze the presence of fertilizer ingredients which are connected with pu but not pe attributes. Raw data can then be projected onto these regions prior being releases for the agents. An algorithm called analyze-then-search (ATS) [5] which analyze the presence of fertilizers in the soil and enable a point where sensors sense the data and search for the matching propagations for the crop production. Then a framework is developed which seeks the gap maximization between public and private attribute covariance's and data regions where it will suite for crop productivity with minimum fertilizers.

ATS algorithm

Input: Parameters to get evaluated

Output: Efficiency of the model

X= raw data

X1= fert data

Y+ = ingredients of the fertilizers used (public attributes) Y- = ingredients of the suggested alternate fertilizers with less health risk (private attributes)

B. Inputs to this function

X - M x N matrix. M is the no of raw data samples and N1 is their feature dimensionality

pu labels: M x N matrix, pointing out the presence /absence of N2 pu attributes

pe labels: M x N matrix, pointing out the presence/ absence of N3 pe attributes

D - the maximum dimension desired (Threshold distance to fix monitoring sensors in farms)

Lambda: tradeoff parameter between pu / pe labels used in the objective function (default is 1).

σ_X _ Estimated value

We have to measure the classification accuracy for FRET

$$F=\sigma_X (\forall F\{Y-/Y+,g(f(X, X1))\}) \quad (1)$$

A pervasive system in agriculture [5] provides a means to monitor the application of fertilizers, nutrients and manage both the quantity and quality of agricultural produce. I am trying to analyze the investigate yield gaps and the fertilizer applying strategy for a farm. After analyzing the fertilizers used for high yields in the farms, the ingredients and the percentage of involvement of these has to be analyzed. The fertilizers which cause risk to health has to be monitored and we have to suggest a similar fertilizer with less health risk to the farmers. Two main censorious findings emerged from the analysis. The first is the metric to which fertilizers limits increases in crop yields. The second metric was the relatively large amount of yield increase possible for a small, yet affordable amount of fertilizer application. We are trying to build an efficient framework for healthy fertilizer applications.

Recommendation of crop

Recommendation of crops is a helpful tool which provides a solution to an important part of the process of cultivation.

Random Forest is an ensemble method which can be used forboth classification as well as regression. It consists of a number of decision trees which output their results and the majority of these is provided as the result of the application of the algorithm. It is the most probable result and also prevents over fitting. Thus, considered as a suitable algorithm for many predictions.

The user provides inputs about the district and the season in which he prefers to grow crops. The Random Forest algorithm is applied on the available data, which ranges over several years and with the necessary data. Then, the majority answer from the various decision trees built on the data, is chosen as the final result of the algorithm. This result is the recommended crop to the user, which is to be grown in that particular region and in that season.

IV. WORK CARRIED OUT SO FAR

The design for fixing the sensors on the farm areas based on location aware computing is analyzed. For doing the analysis we have taken all the possible distance management methods [2] for putting the sensors for calculating the least cost of implementation. The agricultural areas will be large for monitoring the need of fertilization and the water levels, sensors has to be fixed in intermediate areas. We analyzed that the Elliptical Location strategy is the best for energy efficient and least cost method for fixing the sensors in the farms. The registration of each of the unit and the communication between each of the nodes are analyzed.

A. Registration process

1. The System enters a new Location Area and transmits a LOC (location update) message to the new Base System.
2. The Base System forwards the LOC message to the Context aware Service Center [1] which launches a registration query to its associated Context aware Location Register.
3. The Location Register updates its hash table based on the location of the sensor where user belongs to. If the new Location Area belongs to a neighboring area, not matching with the current area, then the new leader identifies the location of the main coordinator. This will be done by a Context aware System from its context aware identification number (ID). The process is achieved by a table lookup procedure called global title translation. The new leader then sends a Done message to the main coordinator. When the Done message receives from all the leader's coordinator declares location registration is complete.
4. The main coordinator performs algorithms to authenticate the context aware system and records the ID of the new serving leader of the Terminal. The main coordinator then sends an acknowledgment message ACK to the new leader, and the procedure continues.
5. If any leader fails to deliver a Done message to the coordinator. Then the coordinator sends a cancellation message ABORT to the previous leader to cancel the registration.
6. The previous leader removes the record of the sensor and returns a cancellation acknowledgment ABORTACK message to the coordinator.

B. Computing Procedure

Algorithm for the performance analysis for the yield of the crops

If I is the set of crops, j is the set of ingredients used for preparing pesticides, p is the set of pesticides, Rij is the yield of growth of crops.

Among j: j1, j2, …. jn. If h1, h2….hn are the ingredients having high health risk. By removing any of the h's from p, still not much variation in the yield of the crops, then that h's has to be removed for the betterment. To analyze the risk of cancer or any other infective viruses from the agricultural crops. The performance analysis graph can be checked by reducing the health risk.

Coordination algorithm in execution nodes

1. Begin execution of analyzing the sensors location
2. Set success:=true;
3. Execute application operations;
4. 4. if (fail to execute current location) then success:=false;

5. Repeat Step 3 and 4 until ((all analysis operations finish) or
(not successful))
6. if (success) then send Done message to leader;
wait incoming message;
if (receive Confirm message) then report execution results to leader;
else if (receive Abort message)
then execute sensors compensating stage; send Aborted message;
else rollback to previous state;
send Failed message;
7. End

Performance Evaluation of the above algorithms and the mathematical model prescribe a new system capable of monitoring context aware systems more accurately. The time taken for the apprehension of the context aware systems at various capacities of the high way micro-section has to be computed through simulation.

TABLE – I: Simulation Parameters

	Deviation	Node Vs Direction of Movement Area					
		CLA Location Update	*ELA Location Update*	*CLA Paging*	*ELA Paging*	*CLA Total*	*ELA Total*
Simulation	0.25	0.04	0.02	0.010	0.02	0.06	0.03
	0.50	0.04	0.021	0.011	0.02	0.06	0.04
	0.75	0.04	0.030	0.014	0.02	0.06	0.045
	1.00	0.04	0.032	0.015	0.02	0.06	0.050
	1.25	0.04	0.034	0.017	0.02	0.06	0.052
	1.50	0.04	0.036	0.018	0.02	0.06	0.054
	1.75	0.04	0.038	0.02	0.02	0.06	0.056
	2.00	0.04	0.04	0.02	0.02	0.06	0.058

Classification of crop using ANN

The following is pseudo code:

Begin

//Import the dataset

data=read("Crop_Production.csv")

//Adding class labels

if production<threshold:

class=0 // low yield crop

else:

class=1 // high yield crop

set x= predictors

set y=response

encode the categorical variables

split the dataset into training and test dataset

//creation of artificial neural network

create_ann (hidden_layer=1,neurons=3,optimizer=Adam, activation= relu,sigmoid)

//training

train the ANN on the training data

//testing

test the ANN on the test data

calculate the accuracy

Forecasting:

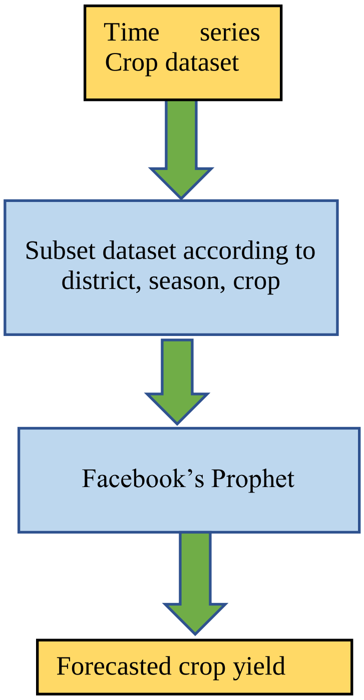

Fig1: Overview of forecasting of crop yield

Fig 1 represents the overall architectural view of the process of forecasting the crop yield. The time series crop dataset is a yearly dataset on the crop yield in various states and districts. Only the subset of dataset with state Karnataka is considered for forecasting. Further the subset of dataset as per the input from the farmer is considered.

Facebook's prophet forecasting algorithm is applied on the dataset. The algorithm requires the number of periods for which the forecasting has to be done as input. The output consists of forecasted crop yield for the mentioned number of periods.

V. RESULTS

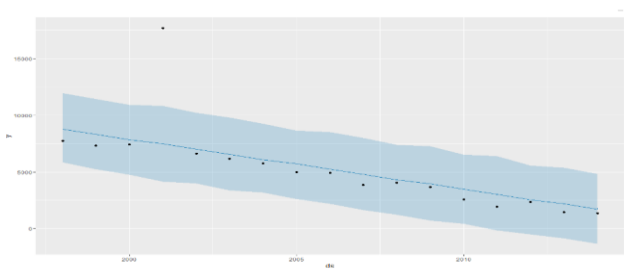

Fig 2: output of classification of crops by using artificial neural network

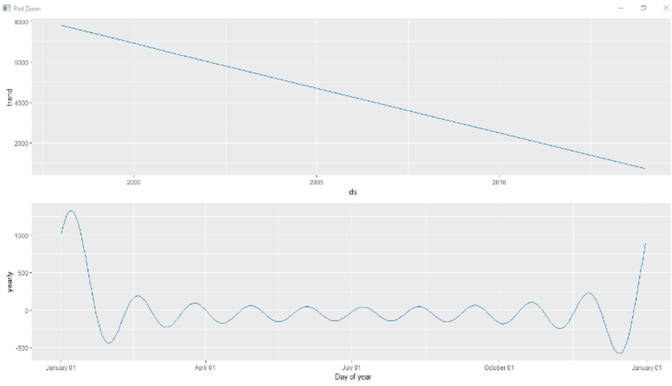

Fig 4: Trend and yearly seasonality

Fig 2 shows the output of classification of crops by using artificial neural network.

Fig 3 shows the plot of Actual and forecasted values of the crop yield.

Fig 4 shows the trend in the time series dataset as captured by Prophet. The plot shows a linear downward trend.

Fig 5 shows the actual and forecasted values. The forecasting model have performed well which can be seen from the difference between the actual and forecasted values.

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