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Smart Farming System Using Data Mining

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***Abstract* – Smart farming system is modern & adept technology developed, which makes use of smart & hi-tech agriculture methods for maximize the crop yield by smartly managing them. The implemented smart farming system provides autonomous and sophisticated mechanism to improve crop yield. The paper will debrief about overview & software been developed for current system. The system makes use of several parameters for functioning includes data mining methods, satellite weather info, internet based searched data & etc. Clustering algorithm is used, that decides the output according to the historical data present in dataset. Smart farming system gives the suggestion of using adequate amount of water without wasting it according to certain parameters also fertilizer to be used to increase crop yield and pesticides to be used in case of any diseases or insect attacks.The system is exact solution for increasing the field productivity & producing maximum crop yield without wastage of resources.**

Keywords: Data Mining, Satellite Information, Preprocessing, Smart Decision System**.**

I. INTRODUCTION

The modern technology has a major role in developing the agricultural industry. It have made us possible to grow crops in a desert because ofits advance intervention.Technological growth has been the major driving force for increasing agricultural productivity and promoting agriculture development. In the past, the choice of technologies and their adoption was for increasing thequantity, productivity and farmers income.

There are various physical factor, market factors, environmental factors, other factors that affect the crop yield. In this paper we are going to focus on physical factors i.e. water requirement for particular crop at particular environmental conditions also the fertilizer requirement of crop according to crop and soil conditions (available nutrients in soil). Also fertilizer to be applied on crop according to environmental condition that came under both physical and environmental factors.

About approximately 70% of Indian economy is based on agriculture. In spite of all such problems, agriculture is a cardinal source of employment and plays a key role in socio-economic development of India. So, there is need to have Dynamic control over the agriculture system. Also population is increasing day by day so the need of food also goes on Increasing. So, in order to improve the condition, we can make use of technology in smarter way. In order to make this Possible we need more productivity from farming. The domestic and industrial sectors account for 10% and 20%.Data mining predict future trends and behaviors according to the

knowledge driven decision. An automated analysis offered by data mining methodology reaches beyond the summary of past events, provided via respective tools typical of decision support systems. The data mining techniques are result of a long process of research and product development. It is ready for application in the business community because of following factors.

- Massive data collection.
- Powerful multiprocessor computers
- Data mining algorithms.

Data mining is the process of finding adequate data in large quantity of previously known data, and then its use in important business decision making. Basically, Data mining is used for all data mapping & processing. The technology of data mining is narrowly connected to data storage and is intertwined with database management system. The aim of data mining is to get information from the data set or historical data and the by applying algorithm transform that information for further use. In short Data mining is the process of finding correlations or patterns among dozens of fields in large relational databases. Here, K-nearest neighbor technique is used for smart farming decision making.

In this paper the focus is given of three areas of agriculture i.e. water requirement for cropat particular soil condition, crop stage, temperature, etc. The second area is Fertilizer,i.e. the fertilizer usage depends on soil condition and crop condition. Soil condition basically depends on the available micro-nutrients as well as macro-nutrients. The Third area is the Pesticide i.e. the Pesticide usage is sharply depend on the environmental factors i.e. humidity, pollution, temperature, etc.

There are various physical factor and environmental factors that affect the decision about the Water, Fertilizer and Pesticide usage for crop. Smart farming system covers 3 issues of farming-

1) Water required for crop at particular Day/Stage.
2) Fertilizer to be used at particular stage according to the micro-nutrients (Nitrogen, Potassium,

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Phosphorous) as well as Macronutrients (Calcium, Magnesium, Sulphur) present in soil.

3) Pesticides to be used depend on various environmental factors such as humidity, Pollution (air, soil and water) etc.

II. LITERATURE SURVEY

There are various traditional techniques available for irrigation, ex. Traditional sprinkler system and Rotary system for irrigation[1]. These are the manual techniques but we need dynamic control over the residential irrigation system, due to the water wastage. So, various dynamic controlled hardware/software systems came into picture.

Irrigation System- In the first Hardware/Software based irrigation system hardware (sensor) and software (Desktop application) the Iris scheduling software is used. Iris scheduling system provide expert system irrigation advices using automatically collected or manually inserted data and also it is a freeware software. This system is quite complex which collect the data from different sources i.e. such as whether station, sensors satellite information and data from Internet and from database available. From whether station, sensors satellite information and data from Internet information related to whether is collected. And from Internet and database available the other information required for processing will be collected. Other sensors are used for monitoring plants their growth rate, chemical exchange, response on irrigation. . This system uses expert system and artificial intelligence methods and algorithm for interpretation of data On the basis of this data it provides real-time decision about current irrigation time as well as about future. Also lots of mobile based irrigation system came into existence one of them is Arduino UNO (Open source prototyping platform depend on user friendly hardware and software which can be customized according to user need)[2]. It is programmed in such way that it can sense moisture level in soil with hydrometer sensor and inform Arduino UNO. If the moisture level is below threshold for particular crop, then notification of water required will be send on farmers mobile App from the Arduino UNO. Both of the above systems are costly as it requires huge hardware. And if suppose any of the sensor or hardware stop working then whole system will collapse or go down. So, we need more effective system that gives result even when hardware fails. There comes the smart farming system that gives result by matching the patterns and take smart decisions.

Fertilizer system- Fertilization decision system is commonly designed for soil nutrient evaluation, management and crop fertilization by integrating information technology, with soil quality evaluation and crop fertilization theory, to achieve the comprehensive utilization of the knowledge of the expert. This knowledge based fertilizer decision system was designed in C++.This system works in 4 stages[3].

1) System Objects- Knowledge about Soil, nutrients, Crop, Fertilizer's properties, crop related properties, etc.

2) Fertilizer Knowledge- Knowledge about last fertilizer used, fertilizer absorption rate etc.

3) Relationship between objects and knowledge.

4) Fertilizer knowledge representation and storage.

In order to facilitate fertilization decision, 4 knowledge base are implemented i.e. Basic knowledge base, Nutrient evaluation knowledge base, Fertilizer rate calculation knowledge base, Fertilizer allocation knowledge base[6-7]. But, the time required for processing of this system is more and unable to handle huge amount of dataset also the time required for processing this data is more

Pesticide- Pesticide Decision System is designed to protect crops from diseases and insect attack. It also helps to increase the crop yield[8]. Insufficient knowledge of farmer about the pesticide usage causes harmful impact on the environment, the economy and human health. So, some less harmful pesticides are identified then develop and populate database. According to that the pesticide determination takes place in smart phone application. But, in this system focus was only given on collection of 62 harmless pesticides[4]. But considering 62 fertilizers is not sufficient so, all the diseases on plant should cover and also the solution of the unusual disease on plant is given. Also the wireless monitoring system was introduced it aims at reducing the level of the pesticides and ensuring a high quality production[9]. A wireless sensor network is designed, which determine the disease development during the growing season.

III. SYSTEM DESIGN

The main objective behind the smart farming system is to provide better determination to farmer for high yield. In this system all 3 areas i.e. Irrigation, Fertilizer and pesticide that affect the agriculture yield is considered. Smart farming system is a web application with huge amount of dataset or historical data available in backend. The data mining is used in the process of finding correlations or patterns among the dozens of fields in relational databases. Clustering algorithm is used for that purpose. Clustering is the process of making a abstract objects into classes of similar object. While doing cluster analysis, we first partitions the set of data into groups based on the data similarity. There are various clustering techniques available from that k-nearest neighbor technique is used.

The basic requirement of this system is to have the current soil details of farm i.e. the available nutrients in soil. It includes micro-nutrients (Nitrogen, Potassium, and Phosphorus) and macro-nutrients (Calcium, Magnesium, and Sulphur). To exact current soil details soil testing is required. So, initially soil sample is to be send at Lab. After getting the soil details Farmer have to insert all the soil details (which include nitrogen, potassium, phosphorus, calcium, magnesium, etc.) in application. These details are necessary for prediction of water required, fertilizer and pesticides.

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Along with this at the time of Registration you have to input exact farm location that will be useful to get the longitude and latitude of farm. This is useful to get the exact temperature of farm area. The temperature information is identified from online sources such as from satellite and online sources. At initial stage user/farmer have to fill the crop details i.e. Crop name, crop stage, soil condition, etc. Following block diagram shows the flow of smart farming system.

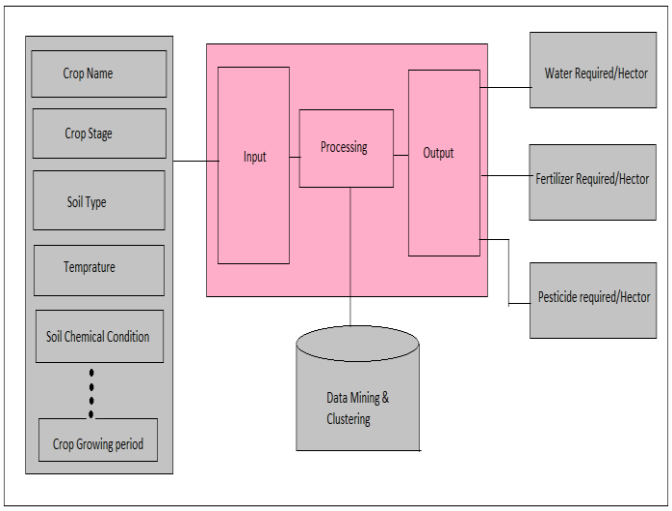

Fig. 1. Flow of smart irrigation system

The block diagram shows that initially input parameters such as crop name, crop stage, soil condition, temperature, etc. are the basic input parameters. All the inputs are send for processing. For processing we are having huge amount of dataset which is collected from last year's surveys and other different sources. For processing data mining is used and for that K-nearest neighbor clustering algorithm is used which will find the correlations or patterns among dozens of fields in large relational databases. After processing system will give the results according to the user requirement i.e. either water required /Hector, Which fertilizer to be used at that current stage or Pesticide to be used if crop suffers from any disease.

In the following section each agriculture area is explained in detail that how it works to take smart decisions.

Irrigation system- Irrigation module gives the result as the water required for a crop at particular time. The water required is given as per the Hector. The input parameters are Crop name, Crop stage, Soil condition, Eto (Evaporation rate), Two days temperature (Current day and next day), Kc (crop factor), etc. For processing we are having huge amount of data set of previous years. There are certain important fields are there in dataset i.e. crop name, stage, soil condition, temperature, year, productivity, etc.The target data set must be large enough to contain these pattern. Productivity is nothing but the percentage of crop yield in that year. This productivity percent will be decided at last after we get crop. This data is collected from surveys, etc.

Evaporation Rate (Eto) –The amount of water gets evaporated depends on climate. The higher the values of evaporation rate is found in area which are hot, dry, windy, sunny whereas low values are observed in area where it is cool, humid, cloudy with little or no wind. To calculate evaporation rate the following formula is user.

$$\mathbf{Eto = P(0.46\ Tmean+8)}$$

Where, Eto – Evaporation rate, P - Mean of longitude & latitude Tmean -Mean of daily temperature Current day, next day temperature

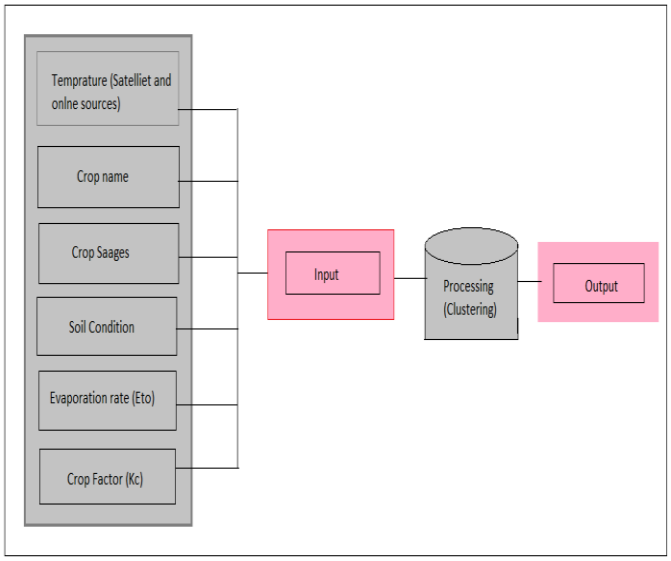

Fig. 2. Block diagram of smart irrigation system

Block diagram shows the working of smart irrigation system it takes temperature, crop name, crop stage, soil condition, crop factor as input. All this input are preprocessed. Here k-nearest neighbor clustering algorithm is used and pattern matching is done according to the mean of temperature, crop name, stage, soil condition. It will give the cluster of results. Now, the result gets selected from according to the highest productivity that the farmer/user get at particular year by using the particular amount of water. The result of water required will be given according to the highest productivity of previous year. After getting the result it will return as the output as the water required per hector. More accurate result according to productivity of previous year will get selected and required water amount per hector will be predicted.

FertilizerSystem- Fertilizers are basically use to increase/enhance crop yield. Traditionally farmer apply fertilizer to farm as per they think or as per the advice given by vendor but, without knowing the available nutrients. This will directly affect crop yield. So, it is mandatory to do soil test before using fertilizers.

In the Fertilizer system the Name of fertilizer is depend on the crop name, Crop stage and soil condition. Whereas, the amount of fertilizer to be used is depend on the soil available nutrients that include but micro-nutrients(Nitrogen, Potassium, Phosphorus) as well as macro-nutrients(Calcium, Magnesium, Sulphur) [6-7].History of crop will be kept in data set. If pH level<7 then the soil is alkaline and if pH>=7 the soil will be saline.

In the Fertilizer module soil testing is mandatory that help us to identify the proper amount of fertilizer to use according to

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available nutrient, crop stage etc. Block diagram gives clear idea about fertilizer system.

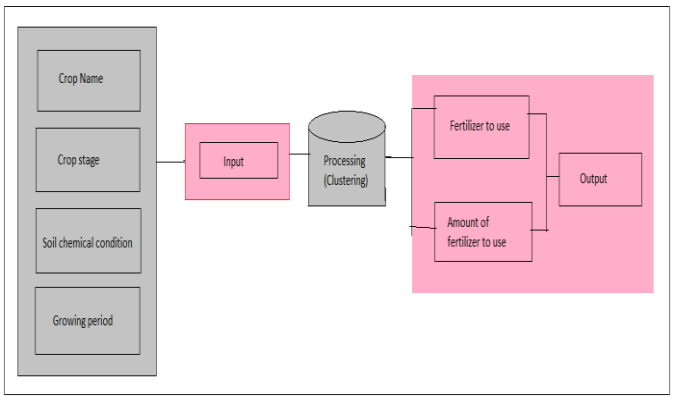

Fig. 3. Clear approach smart irrigation system

Fertilizer module takes crop name, crop stage, soil chemical condition and growing period as input then this inputs are preprocessed i.e. Data mining technique will be used for clustering. Here clustering is required as we are having uncertain results of productivity. Here also the result will be given according to the highest productivity. First the cluster will get form according to the crop name, crop stage, soil condition, humidity, mean of temperature and the soil nutrients and then the result will be given according to highest productivity. The output will be the fertilizer name, quantity of fertilizer as well as its usage i.e. for how much days we need to apply that fertilizer.

Pesticide-Pesticide module is crucial for prevention of disease & quality control. Excess or incorrect of use of pesticide causes side effect on crop so it is necessary to apply proper amount of pesticide. To increase the crop yield it is necessary that the crop should be disease free. Number of factors that causes disease or that tends to use of fertilizer are humidity, temperature, sudden change in environment, excess use of water, water pollution, air pollution, soil pollution(due to industries around farm),etc.
All this factors are the input parameters to the system which are taken from different sources such as temperature is taken

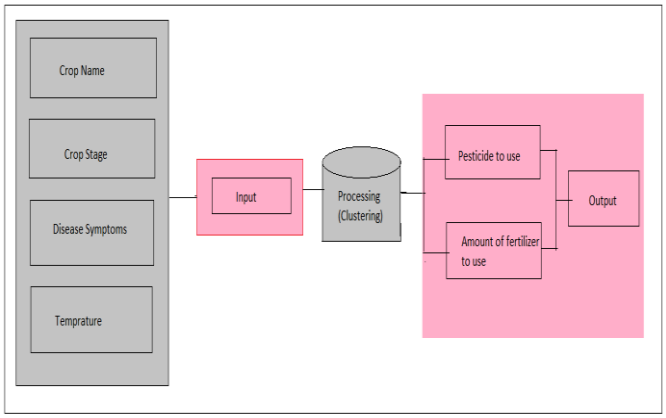

Fig. 4. Block diagram of pesticide management in smart irrigation system

either from satellite or from online sources, current day humidity will be taken from the online sources, all else factors will be selected from farmer/user along with the symptoms of disease for example certain kind of disorder, holes in leaves, insect attack on crop, leaves getting red (lalya disease), etc.
All the input parameters are considered as input and send for processing. While processing all the parameters get match with the historical data that is present and for that clustering algorithm is being used. Then the name of pesticide to be used, amount of pesticide and its usage i.e. number of days to be used will be suggested and given as output.

IV. SYSTEM RESULT

Data mining is the methodology of finding correlations or patterns from dozens of fields in large relational databases. If the exact match is not available is system will give the approximate results so, in case due to any reason any of the parameter is missing at that time at that time it will not affect the whole system or system will not goes down. After applying test cases the on all the three module the following graph is plot for one case.

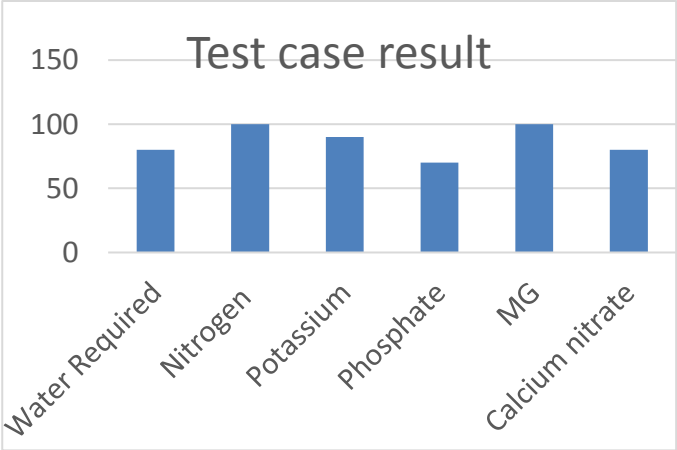

Fig. 5. Test Case Result

Here, the main test cases are cover as in first case the result is showing as 80% accuracy for the amount of water to be apply(irrigation water) as, there is no exact match in database to system will give the approximate result so the accuracy of the system gets reduced. In the same way the second test case shows the 100% accuracy as the result of exact match was available for that particular input. Then in the same way the test case for potassium and phosphorus was applied and for potassium 70% of accurate result was given by system and in case of phosphorus 100 % of accurate result was given.

V. CONCLUSION

This paper covers the approaches & techniques of smart farming system which is reliable solution for producing the maximum crop yield. The smart farming system is more advance & redeeming than the previously existing solutions. It

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covers all the major area of farming including irrigation, fertilizer, and pesticide. It makes use of data mining &clustering algorithms which actually uses robust pattern data miningclustering algorithm for giving the exact output as per input parameters by considering future conditions can arise like considering next day temperature as well as humidity, also by being smartly aware of all farming parameters currently available. Its autonomous nature makes it independent working unit, as there's no need of human intervention. It will accurately focus on cultivation & growth of crops, future prediction of resources & methods to produce max yield. Its sync with satellite & internet based weather updates will keep tracking any critical condition which can rise in future & it will also pre-alarm about same to users if is to be occur in near future. It is developed for smartly managing the available resources, specially a limited resource like water without been over or under used & wasted. It is most prominent & adept futuristic solution for survival in farming.

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