Enhancing the agro engineering system using game theory analytics

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Abstract: The advent of technologies and the impact of computer play an essential role in performing regular activities. The new era of Big Data analytics helps in analyzing the data through primary data and secondary data. By using modern tools to handle Distributed File systems enormous data can be handled and processed with high speed and accuracy in a stipulated time. The use of these emerging trends in all the fields gives better solution and strives the world in all aspects of digitization in a successful manner. To produce high yields in food crops, the agriculture adopted modern industrial systems. By using modern tools and techniques the agricultural production can be increased abundantly. The proposed system will help and attract the common people to invest their hard work and time in agricultural production, and make a huge contribution in the financial growth of the nation. The tractors and agro engineering tools for irrigation systems, are already used to improve the production of food crops. But the lack of advanced techniques such as smart system for monitoring the crop, to look for the strength of the soil through soil analyzer, checking for moisturisation in land and air, etc., are very much needed for proper yield. This system presents the novel framework and initial experimental results shows the feasibility of proposed system.

Keyword : Sensors, Big Data Analytics, Game Theory, Agro-Engineering

1. Introduction

Several Internet facilities and policies have been framed and put into practice by many governments all over the world in order to strengthen the agricultural fields. The basic need is to monitor all the parameters such as quality of soil earth we live-in, soil properties, weather predictions and this in turn alerts farmers, ranging from miniscule to large scale farmers to control these basic needs when required. In the year 2015 a policy framed by Ministry of Communication and Information Technology, India to transform digital landscape on Internet of Things and it was reported in the year 2019 to achieve superiority in the use of Information and Communication Technology (ICT) and to uplift our Indian factor to greater heights in the agricultural sectors. Australia, Ireland, France, China, Malaysia, USA, Thailand and Philippines are some of the other countries where IoT has been successfully implemented over the years from 2014 to till date.

The main objective of this proposed system is to inculcate the agriculture practices using innovative technologies and help in reducing global warming and make earnings for their healthy and happy life using smart Agro System. It helps in analyzing the soil, improvisation in irrigation system and monitoring
the crops using emerging sensor technologies and Big Data Analytics for processing and accessing the
data quickly. Also by using Cloud Computing technology the communication can be shrunk with the hand
held systems such as Mobile phones, i-pads, etc., which help the agriculturists to sell their yields in a
profitable way.

2. Existing System

Agricultural field monitoring is a laborious and tiresome process[4]. It can be simplified and made
profitable by reducing labor input and identifying the solution within a few seconds. Recent advancement in
ICT and data management[6],[7] made this possible with the help of computers and Internet facilities[1].
Several Internet facilities and policies have been framed and put into practice by Government of India in
order to strengthen the agricultural sector[2]. The basic need is to monitor all the parameters such as
quality of soil-earth we live-in, soil properties, weather predictions and this in turn notifies the farmers,
ranging from miniscule[17] to large scale farmers to control these basic parameters when required.

Through the policy of India, to achieve superiority in the use of Information and Communication
Technology (ICT)[10] and to uplift nation factor to greater heights in the agricultural sectors. Australia,
Ireland, France, China, Malaysia, USA, Thailand and Philippines are some of the other countries where
IoT [13] has been successfully implemented over the years from 2014 to till date. By not encouraging the
irrigation transfer in many countries like Korea lead to lack water scarcity for the crop production. The
aged farmers, lack of youth interest in rural livelihoods, unclear water-pricing structures support and lack
of irrigation system and private investment, such social and demographic phenomenon has further eroded
the self-governance capacity of rural communities

Most of the past surveys were done in water management, crop management, irrigation patterns,
aricultural productivity, global population, effectiveness of the agricultural production, soil conditions
such as pH, humidity, environmental temperature and soil moisture. All existing systems, for example
Object-oriented[15] expert system, Radial basis function networks, Rule based expert system, Artificial
neural networks, Fuzzy Inference Systems, Image Processing, etc., concentrate on one or two
parameters[14] at a time and their outputs are useful for cultivating[11], [12] only one crop [18] under
similar weather conditions. Even if slight temperature variations in the parameters occur, the results [13]
are not accurate to the extent desired. Also in most of the systems, the outputs are transmitted through
internet facilities, processed and displayed in the monitor which is located indoor or within a nearby
location.

To overcome these disadvantages there is an urgent need for an innovative application[8] that can be
operated anywhere[12] around the country and monitor the agricultural lands [9][10] that are far from the
reach of the farmers. To obviate the above disadvantages, a Smart Agro based System is proposed. It has
been initiated to develop a Smart Agro based system that can be installed in smart phones which will be a
handy tool for small scale as well as large scale agriculturists.

3. Proposed System

The main objective of this proposed system is to inculcate the agriculture practices using innovative
technologies and help in reducing global warming and make earnings for their healthy and happy life
using smart Agro System[14], [16]. It helps in analyzing the soil, improvisation in irrigation system and
monitoring the crops using emerging sensor technologies and Big Data Analytics for processing and
accessing the data quickly. Also by using Cloud Computing technology the communication [2],[5] can be
shrunk with the hand held systems such as Mobile phones, i-pads, etc., which help the agriculturists to sell their yields in a profitable way.

The development of this system involves three steps:

Step(1): Smart Application for the Process of Soil Analyzes and Monitoring Irrigation Systems

Step(2): Monitoring the crops through Sensors

Step(3): Data Processing through Big Data Analytics

3.1. Smart Application for the Process of Soil Analyzes and Monitoring Irrigation Systems

The process of analyzing the soil for agriculture is a great challenge to the farmers. The proposed system will make a way to overcome this difficulty by processing the soil analyzes and monitoring the irrigation systems through smart applications. The monitoring of the agriculture systems helps the farmers to continuously aware of the quality of the soil (humidity, pH value, etc.,) and monitor the irrigation system.

3.2. Monitoring the crops through Sensors

The crops to be monitored using various kinds of sensors for the protection of crops from pests and worst climatic conditions, etc. By using multiple sensors, the signals indicate any mis-happenings in the agricultural field and thus the remedial actions could be initiated to protect the crops[18]. With the help of micro-programmed chips the received sensor signals are processed and appropriate actions initiated.

3.3. Data Processing through Big Data Analytics

![Figure 1. Smart System for Agro Engineering](image-url)
The distributed system plays vital role in the data processing. By using the Avra and Sqoop in Hadoop Distributed File System so that the data are processed and accessed very quickly. The primary and secondary data are analyzed to predict the health of crops, quantum of production, make use of economical fluctuations profitably. The queries from various users relating to market rates are processed and responses can be provided spontaneously. In the Figure 1, the input will be given to the system and which identifies the problem and check the various factors[18], such as soil, weed control, climatic[14] condition, irrigation system, etc. After the identification of problem[17], it analyze and process the data to provide the accuracy in facts. Data will be analysed on the basis of principles for the equivalence of extensive and coalitional game strategies.

3.4. Elucidation of Game Strategies

An exchange factor that contains two agents \((N = 2)\) and two goods have the preference relation, which can be conveniently represented as an payoff box[3]. Bundles of goods consumed by agent 1 are measured from one the origin in the bottom left, while bundles consumed by agent 2 are measured from the second origin in the top right. The width of the box formed by the two pairs of players is the total endowment of good stage in the factor. The more general notion of an factor with production.

Note that under our assumption that every agent's preference relation is increasing every agent is resource related to every other agent. Thus each point \(x\) in the payoff box corresponds to an allocation in which agent \(i\) receives the bundle \(x\) measured from set of players \(O^*\). The point \(x^*\) corresponds to a competitive allocation since the most preferred bundle of agent 1 in the set \(\{X_1, p_{x_1}, p_{u_1}\}\) is \(x^*\) when measured from origin \(O^*\) using preference relation \(P\),

\[
px_1 P p_{u_1} > X_1 P O^* \quad -----(1)
\]

The ratio of the competitive prices is the negative of the slope of the straight line through \(u\) and \(x^*\). An exchange factor \(wf\) is closely related to factor of a global market. Thus the model of an exchange factor as a coalitional game without transferable payoff has been framed. Precisely, it associate with the exchange factor \((N, I, (wf), (P-))\) with the coalitional game \((N, X, V, (P{}))\) where

\[
X = \{(x_i) i\in N: X_i \in R, \text{ for all } i \in N\}; \quad \text{(2)}
\]

\[
V(S) = \{(X_i) i\in N : S x_i \in w^* \text{ and } x_i = u_i \text{ for all } i \in S\} \text{ for each coalition game. } \quad \text{(3)}
\]

Each preference relation \(P\) is defined by \((x_i)j\in N, (y_j)j\in N\) if and only if \(x\{\} \& y\{\} \).

The third condition expresses the assumption that each agent cares only about his own consumption. Every competitive allocation in an exchange factor[8] is in the core. The idea behind the first solution concept that a coalition is unsatisfied with the current division of \(v(N)\) can credibly object by suggesting a stable division \(x\) of \(v(N)\) that is better for all the members of \(S\) and is backed up by a threat to implement \((x_j)\). The logic behind the requirement that an objection itself be stable is that otherwise the objection may unleash a process involving further objections by other coalitions, at the end of which some of members of the deviating coalition may be worse off. When making a choice at players last information set is not informed of the action of chance, though player was so informed and made with previous choice.

This strategic analysis helps to perform the predictive analysis on the class of the given data set. It also performs well in multi class prediction. The categorical input variables are much useful compared to numerical variable to analyze the data.
4. Results and Conclusion

Initially it has been tested with very few test beds, arrive a best enhanced results and shows the drastic improvement in predictive analysis for the good crop production. The table 1.0 depicts the detection rate for various factors such as soil, water, disease, climate and weed control. It shows enhanced results in time consumption to analyze the data approximately in 10 minutes less and makes the profitable at monetary level by increasing the maintenance of food crop production.

| Description   | Detection Rate Normal | Detection Rate proposed system |
|---------------|-----------------------|--------------------------------|
| Soil          | 90                    | 84                             |
| Water         | 95                    | 82                             |
| Disease       | 97                    | 83.1                           |
| Climate       | 91                    | 81                             |
| Weed control  | 92                    | 83.7                           |

**Figure 2.** Detection Rate of Data Analysis
In future, to sell the food grains in the market, the mobile application will be launched so that the prices for the crops will be amicably fixed by the farmers. No distributors or brokers are entertained in the sale of the products. Thus the proposed system will be very useful for the agriculturists.

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