

A COMPREHENSIVE REVIEW OF DATA MINING TECHNIQUES IN SMART AGRICULTURE

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ABSTRACT

“Agriculture is the Back Bone of India” as leaders of our country made wonderful notes in different events. Those valid quotes must be made true this time throughout our nation we must start educating and improving the cultivation in all provinces of India by studying and analyzing thoroughly about existing agriculture practices in India. Imparting a proper data mining methods right from Mining frequent patterns, Association & Correlations, Classifications, Clustering, Detection of outliers on agriculture related data we can devise a model resulting in meaningful report useful for the existing farmers and next generation farmers. This paper reviews the possibilities to create more opportunities for people in general who want to start farming in open land and another prime idea to improvise and educate the existing traditional farmers to adopt smart farming. To bring a practical approach towards the review, adequate referential contexts are discussed throughout the paper in the areas of Data mining and smart farming.

Keywords: Agriculture, IoT, Data mining, Smart farming, Technologies, Traditional farming.

INTRODUCTION

Innovative advances have sped up significantly, particularly with the appearance of the web and its executions in our day-by-day lives. At one point when we open our eyes means, we can perceive what innovation has meant for each space of human existence, including food, well-being, security, and innovation. Innovation arrives in an assortment of ways and shapes, permitting people to advance and accomplish more. This emotional blast in innovation has set out the freedom to return on schedule and have an enduring effect in the realm of agriculture. In order to innovate thorough understanding of present agriculture practice must be studied. At present agriculture practiced in to variants traditional and smart farming approach.

TRADITIONAL AND SMART FARMING

A. Traditonal Farming and its present scenario

Traditional farming with natural manure in general it's a significant one and it's suitable for a quality yielding of harvests. India has exceptional population, supply needs in the market are high. Hence, the farmers are urged to quickly create the harvests and supply their yields in market. Because of the greater levels of popularity farmers have begun embracing NPK (Nitrogen, Phosphorus, and Potassium) excrements/composts and the conventional common fertilizers are reducing. With the widespread of online media mindfulness, new volunteers venturing into the cultivating area began carrying out conventional yielding techniques and began sparkling and began opening outlets like natural shops and becoming immediate merchants of their produce.

Smart Farming and its present Scenario

Agribusiness are classified by the digitization of farmers worldwide and the ensuing information-driven cultivating brings about expanded utilization of current advances, for example, Farm observing contraptions like to give some examples, soil sensors, distant sensors. These inventive uses of innovations empower the assortment and handling of important ground agri-information and permit different partners in the agribusiness environment to take presciently educated choices. This is just one example of information driven farming. Another important one is imparting IoT in farming which turns into smart farming by automating for an example when a landsape area is becoming dry automatically a soil sensor device will alarm the motor to get started and the water is sprinkled once the level of wetness reaches the soil automatically the sensor stops the motor and the sprinkling of water stops and its repeated whenever the landscape become dry again.

This paper is to understand about all existing researches done related to smart farming which leads to device a data driven innovative farming.

REVIEW OF LITERATURES

We are all living in the era of information. Businesses, enterprises, and government organisations acquire a vast quantity of data. [1][2]The volume of data has only risen as a result of recent breakthroughs in technology to automate and enhance data collecting. The purpose of data collection is to

extract relevant information. The process of knowledge finding in databases is known as data mining. The information in the database that was previously unknown and possibly valuable is the data of interest. As a result, data mining has become a study topic of interest in order to successfully address this demand. Data mining research projects from various institutions and institutes are presented in subdivisions (i) & (ii). [1]An important point to make in the beginning, before anything else, we should have a clear understanding of the Data Cleansing and Preparation process as a project, not as simply the theory. [1]The case studies that follow on the National University of Singapore data analysis projects each contain a connection to the earlier mentioned research to clean data in preparation for warehousing and mining is described as solving the problems facing large corporations with large amounts of structured, semi-structured, and unstructured data using machine learning techniques

(i) Data Mining in Multiple Databases:

(Dr. Liu Huan, 2006)It is basic that numerous data sets are kept in an association. [1]They are gathered to serve different purposes. Information mining in singular data sets has attracted a great deal of consideration. Some reassuring outcomes have been accomplished. It is time presently to consider how we can utilize every one of the information bases in an Organization for information mining. Numerous issues stay uncertain. Critical ones are:

- ❖ Will one data set assistance in the information mining of another data set?
- ❖ How would we be able to consider different data sets all the while for information mining?
- ❖ Can current information mining strategies help in this new circumstance or ought to?
- ❖ We foster new strategies?
- ❖ What is so uncommon about mining of different data sets?

(ii) Discovering Interesting Knowledge in Database:

Since understanding of new knowledge is the seizes new insight, which in certain instances is unobtrusively inferred but in any case may prove to be beneficial (Dr. Liu Bing, 2006). When more and more people believe, and concede, the value of knowledge is assembled from data analysis, there has also arisen an emerging belief that a deeper understanding is needed previous techniques have been devised for discovering concealed (and still present) material in data sets including but are not limited to histograms, barcode analysis, fanning out images and specialized threshold. [2]Although these approaches were effective in mechanical contexts, the problems in this area are often diverse. Another problem is that the vast majority of the examples in the data collection are entirely uninteresting to the user. However, because there are so many choices, it is almost impossible for the customer to discern the difference between those that are helpful to him or her. The process may also employ parameters that will only after they have been evaluated for their relevancy in helping the customer, and the process can be expected to include processes that are essential in the client's business only after being weighed for importance. This problem is an exercise in

attempting to identify the work to be done and then to delegate it to available resources, trained staff.

(Paulo Jesus et al, 2015)Distributed data aggregation is a critical activity because it allows for the decentralized determination of essential global attributes that may subsequently be utilized to guide the execution of other applications. [3]The values are computed in a dispersed manner using functions like Count, Sum, and Average. Some application examples include network size estimation, total storage capacity, average load, majorities, and many more. Many various techniques have been offered in the previous decade, each with significant trade-offs in terms of accuracy, dependability, message complexity, and time complexity.[3]Due to the large number and diversity of aggregation algorithms available, determining which strategies will be more suited to apply in given contexts can be challenging and time consuming, supporting the creation of a survey to help with this process. This paper provides three significant contributions to the state of the art in distributed data aggregation methods. It begins by defining the notion of aggregation and describing the many types of aggregation functions. Second, it provides a concise description of the primary aggregation approaches, which are organised in an arrangement. At last, it gives a few rules toward the choice and utilization of the most applicable procedures, summing up their key qualities.

A. Role of IoT in Building smart cities and home:

(T. Guelzim, M.S. Obaidat et al, 2016) Researched on rapid change in information delivery and consumption in Cloud computing systems for smart cities and homes. [4] Distributed computing has advanced from unadulterated specialized and tight field applications to take care of higher issue spaces in the domains of shrewd homes and urban communities. Through normalized framework engineering, correspondence and data trade, cloud advancements depend on instrumentation and interconnection to give shrewd criticism and to help new limits like computerized intermingling, energy the executives or wellbeing and security.

Keen homes and urban areas can't flourish without information combination, and mining. Overseeing, preparing, and incorporating mass progression of data progressively may just be cultivated with best in class data frameworks designs. Distributed computing advancements are a strong establishment to solidify the actual framework just as to smooth out assistance conveyance stages. (<https://www.sciencedirect.com/science/article/pii/B9780128034545000122>)

B. IoT Layers.

(Zhihao&Yongfeng et al, 2010) The Internet of Things coordinates numerous wired and remote communication,control, and IT innovations, which associate different terminals or subsystems under a bound together administration stage that utilizes open and normalized information show advances, for example, XML/Web Services/SOA [5]. The IoT building squares can be addressed in a few layers to portray its usefulness.

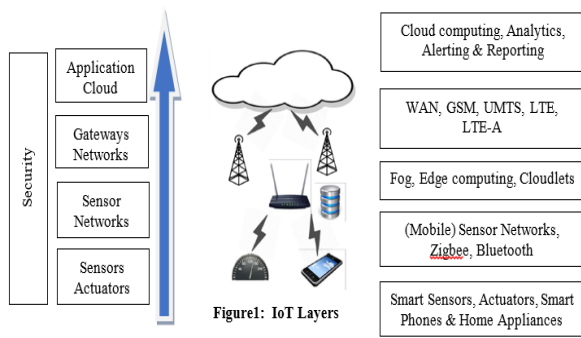


Figure1: IoT Layers

The base layer is the detecting layer where the actual gadgets are found. They are associated straightforwardly to one another and the Internet to shape the sensor network layer. Frequently there is a halfway layer, now and then called mist or edge processing layer. Edge registering is situated at the edge of the sensor organization and improves the cloud framework by preparing information close to the source, i. e. near the sensors. Information can be pre-handled and sifted to save transfer speed and preparing power. Just important information is then communicated to the cloud, where it is put away, broke down and imagined. Figure 1 sums up the IoT layers and its usefulness.

C. IoT contribution in Agriculture.

(Efforts by Debasis Mishra, Kajal Panda et al (2020) and the Department of Civil Engineering at AGRU) will take the seeds to reality: [6] as they expand, they hope to transform these dreams into realities. This research paper analyses various information mining (or data mining) techniques for the Internet of Things (IoT). Personal satisfaction and protection is among the values of Smart Cities espoused is supported by IoT, therefore, in that, asset supply and waste management are a hot topic, and even improvements in traffic and transportation and traffic flow are popular. Extensionalism has profound implications for this approach to Density is impacted by what sort of knowledge is being extracted. [6] In the case of Smart Cities, government may use IoT to improve traffic flow and parking and try to search for openings; for elderly adults, family members, family members or other types of caregivers can use IoT to monitor their progress. The Internet of Things (IoT) is made up of shrewd devices, cameras, streams data, and uses data that is acquired by GPS as well as a source or can help supplement to direct decisions Evidence-specific methods of inquiry can be implemented differently depending on the type of information available. [6] a plethora of IoT frameworks use diverse sensors to inspect their environments for what they have seen, and compare that to expected outcomes in order to gain an understanding of the framework for effectively locating and managing office/crisis safety If the diversity is taken into consideration, knowledge mining tools must therefore have the capability to handle the facts delivered in the large volumes of information that the IoT offers can provide, so several diversity of facts should be supported. This paper looks at cutting-edge approaches to identifying and protecting critical knowledge pertaining to IoT.

(Peter Wlak, Mustafa, and Jeffrey Soar et al, 2017) Discovery of additional value from data in IoT, or a different perspective on the Internet of Things from the University of Southern Queensland share responsibility for overseeing curriculum development in the Faculty of Business, Law and Arts (FWU). [7] This research describes new and emerging techniques for collecting, managing, storing, searching, and analysing Internet of Things (IoT) data (IoT). Much as assets and traffic are considered in Smart Cities, the asset new concepts have emerged with regard to "unique fulfilment" problems such as asset disposal and asset provisioning in the Internet of Things; these new concepts are now considered to be a good prospect in this arena. [6] This characteristic is particularly prominent in DM since the kind of knowledge stored is subject to rigid regulation in that way. A good example of an instance of how IoT can be used is in the medical care will be the way in which it can help elderly patients find nearby parking spots or healthcare systems to get into line where transport systems are involved in municipal operations. [7] For instance, IoT can help with roadblocks for senior citizens to locate parking, which would be found in a Smart City, or elderly care which uses the assistance of the government. Gadgets connected to the Internet are useful as they can collect numeric information from sensors, transmit data from cameras, or use information that can be obtained from cameras to aid the user data. The approach to information processing can vary depending on the type of information that is used. Furthermore, IoT apps monitor input from various sensors and test them in their buildings and send alerts if there are issues with the buildings, while gathering information and using machine learning to predict device failures or conditions that may lead to an emergency. devices of several different types that generate large volumes of data, which are processed at fast rates, necessitate data management strategies that use many data models. An extensive review of the cutting-edge IoT methods is found in this document.

Data Mining in Agriculture

(Sjaak Wolfert et al, 2017) Discovered the problem, risks, threats, opportunities, and issues are along with opportunities and challenges have developed an appropriated distant sensor-based site-specific water device to enhance the directness of precision, but be even less of a drain on resources. [8] GPS, which serves as the framework, gathers all of the data from the five fields and relays it to the base station. This state-of-the-art remote controls have exact and easy to read answers for water systems.

In-depth analysis: [8] The article explains how to use data analytics to track and inspect Big Data farming. There has recently been a great increase in the number of participants, attention, and emphasis, on smart farming practices which puts ICT technology at the heart of every step of the actual board cycle. New technologies like the Internet of Things and Cloud Computing have helped them think about new ways that enable ranchers to enhance their efficiency and cut costs by automating decisions with robots. As you might have already gathered, this expands on "Big Data wonders," which refers to spectacular amounts of knowledge that can be captured, dissected, and used in a dynamic ways. The aim of this audit is to obtain a complete understanding of current big data applications in Smart Farming and to see the substantial monetary difficulties that must be tackled. To this end, a new framework was also developed, which can also be used for further study of the subject, which was formulated via an

ordered methodology. More importantly, Big Data is used in Smart Farming to link farmers to their customers, producers, and has an effect on the whole food supply chain. An enormous amount of information is being used in tasks including gathering and examining data to assist in continual choices over game-changing game strategies and tactical steps, and to try to arrive at prescient bits of knowledge. When several stakeholders expect Big Data to bring in drastic improvements to the workforce and link various networks together, they predict it would have a massive impact on the employment of existing within the food supply chain. The film's partners point is to make it that little companies (next to novices) will exploit big companies (hedgeheeks) and money can be made in the process. In this context, certain governmental institutions release records as long as they take any effort to protect the confidentiality of individuals' personal information. One of two things could happen to Smart Farming: it could be dissolved or taken overvalued. Pre-coordinated development frameworks which keeps the rancher small. While the situation in which they are brought into play does not seem so threatening at the moment, an organization's existence and values can be put at risk through its expansion. Once an item has been used in one inventory, analysis can be done to establish where then it should be recorded in the hierarchical company from the financial standpoint, for example, such as management and proper actions for part use in various network circumstances.

(Shweta gupta et al, 2018) Developing a scalable, production-ready, cross-ready, and time-and-consistent algorithms to expand the role of Data Science in Indian industry- Regardless of how important the role agriculture is in the Indian economy, the people there are always looking for support in the areas where it has deficiencies. [9] Rural populations, which makes India a nation of over a billion people. Of the total population of India, 70% are located in the regional areas, or rural areas, making it a country of more than a billion people. Farmers, who employ a third of the people in India, wield a considerable amount of power on the overall economy and the financial life of the nation. regardless of this, 16% of the GDP is allotted to the \$2.3 trillion economy reflects the amount of expansion this country is prepared to provide Agriculture in India requires a lot of institutional attention, coupled with government assistance, frequent droughts, overvalued land, occasional climate change, shortages, seasonal variations, injustice against rural folks, and so that are resulting in farmers leaving the land, a need for new irrigation projects and regions without water, the inability to afford their products, as well as livestock being removed from farm areas because of drought and inequitable pay to move into urban areas. [9] The government services (local, state, and federal) which are all concerned with every one's well-being have such expansive tasks in agribusiness that the last place to concentrate on is individuals working in it is agrifood production. Since formerly damaged structures have fallen into ruin, the potential has arisen for new organisations to become masters in the process. Opportunity for creativity has often arisen for modern computer systems and programmes to become invigorated as problems seem to surface incessantly in original endeavours.

(Z. Li, J. Wang, R. Higgs, L. Zhou and W. Yuan, et al 2017) China is a huge horticultural country with the biggest populace on the planet. [10] This encourages a high interest for food, which is inciting the investigation of top caliber and high-yielding harvests. China's present horticultural

creation is adequate to take care of the country; notwithstanding, contrasted and created nations rural cultivating is as yet lingering behind, chiefly because of the way that the arrangement of developing agrarian harvests did not depend on amplifying yield, the last would incorporate logical planting, water system and treatment. In the previous few years numerous occasional natural products have been made available for purchase in business sectors, yet these yields are filled in customary in reverse agrarian nurseries and huge scope changes are expected to modernize creation. The change of limited scope nursery rural creation is generally simple and could be executed. The idea of the Agricultural Internet of Things uses organizing innovation in rural creation, the equipment part of this agrarian IoT incorporate temperature, dampness and light sensors and processors with an enormous information handling capacity; these equipment gadgets are associated by brief distance remote correspondence innovation, like Bluetooth, WIFI or Zigbee. Truth be told, Zigbee innovation, as a result of its helpful systems administration and low force utilization, is generally utilized in the farming web. The sensor network is joined with grounded web innovation, as a remote sensor organization, to distantly control and screen information from the sensors. In this paper a brilliant arrangement of nursery the executive's dependent on the Internet of Things is proposed utilizing sensor organizations and electronic advances. The framework comprises of sensor organizations and a software control framework. [10] The sensor network comprises of the expert control place and different sensors utilizing Zigbee conventions. The equipment control focus speaks with a middleware framework through sequential organization interface converters. The middleware speaks with an equipment network utilizing a hidden interface and it additionally speaks with a web framework utilizing an upper interface. The top web framework furnishes clients with an interface to see and deal with the equipment offices; executives would thus be able to see the situation with farming nurseries and issue orders to the sensors through this framework to distantly deal with the temperature, mugginess and water system in the nurseries. The principle subjects shrouded in this paper are: [10] 1. To explore the current advancement of new advances material to farming and sums up the solid focuses concerning the use of the Agricultural Internet of Things both at home and abroad. Additionally proposed are some new techniques for rural nursery management. 2. An investigation of framework necessities, the clients' assumptions for the framework and the reaction to needs examination, and the general plan of the framework to decide its architecture. 3. Utilizing computer programming to guarantee that useful modules of the framework, quite far, meet the necessities of high union and low coupling between modules, likewise nitty gritty plan and execution of every module is thought of.

Based on a (Chun-Wei Tsai et al 2014) survey on Data Mining for Internet of Things, [11] It sounds like mission impossible to connect everything on the Earth together via Internet, but Internet of Things (IoT) will dramatically change our life in the foreseeable future, by making many "impossibles" possible. To many, the massive data generated or captured by IoT are considered having highly useful and valuable information. Data mining will no doubt play a critical role in making this kind of system smart enough to provide more convenient services and environments. This paper begins with a discussion of the IoT. Then, a brief review of the features of "data from

IoT" and "data mining for IoT" is given. Finally, changes, potentials, open issues, and future trends of this field are addressed. URL: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&number=6674155&isnumber=6734839>

D. Datamining steps

Data Collection	<ul style="list-style-type: none"> • Selection of Resources • Historic and real-time data collection
Pre processing	<ul style="list-style-type: none"> • Data Cleaning • Relevance Filtering
Data mining	<ul style="list-style-type: none"> • Selection of data mining algorithms • Training and Evaluating the model
Post Processing	<ul style="list-style-type: none"> • Correlation analysis • Predictive analysis

Table1: Data Mining Steps

This is a top-down approach applied while data mining initiated:

- Data Collection is the first phase whereby Selection of appropriate resources related to the area of research. Here we retrieve information from Agriculture related historical data.
- Pre-Processing is the next level in mining process. The data collected earlier are analysed, filtered by removing irrelevant data and keeping the data which is required for proceeding further in the research.
- Data mining is the important phase, the filtered data based on relevance are evaluated by applying series of suitable algorithms, train the model to bring the expected outcome. At this phase we identify a suitable algorithm for our result outcome.
- Post Processing is where we correlate and predict certain conclusion in our research. Which is must important and becomes a justifiable result.
- Data mining - A Sample source from Tamilnadu Government portal (Source: <https://www.tnagrisnet.tn.gov.in/>)

Table2: Cereal Cultivation year wise tabulation in hectares

S.No	CEREALS	AREA UNDER CULTIVATION - CROP WISE (in hectares)				
		2015-16	2016-17	2017-18	2018-19	2019-20
1	Paddy	2,000,212	14,42,841	18,28,919	17,21,265	19,07,407
2	Maize	3,55,064	3,15,030	3,24,518	3,90,602	3,33,565
3	Cholam (Jowar)	3,39,166	2,68,391	3,85,646	3,85,842	4,50,000
	Total Cereals Yield	2,694,442	2,026,262	2,539,083	2,497,709	2,690,972

are segregated year wise from 2015 – 2020. Total yield of all three cereals are calculated in hectares every year. Similarly rest of the years yield is calculated and a visualization is retrieved. The Table.2 data and Figure.2 visual is brought to understand the basic outcome of a yield every year. Based on this outcome predictive analysis is possible to incorporate and we can analyze the data further by applying data mining flow of technique and can be able to predict the next year i.e., 2020-21 yield. Based on individual crop growth every year we can predict a particular crops growth in the next tenure. Keeping in mind the possibilities of applying predictive analysis approach in agriculture field the whole review is made, which leads to a scope of more improved data mining techniques in Agriculture field.

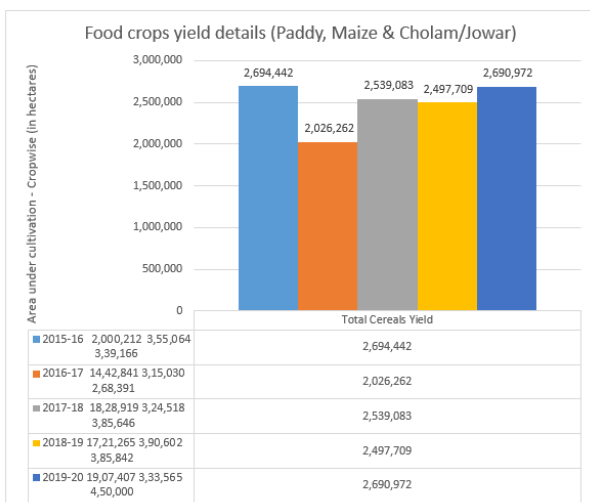


Figure2: Cereal Cultivation year wise tabulation in hectares

Three different cereals Paddy, Maize, & Cholam (Jowar) yield details are retrieved (Last five years of historical data). They

CONCLUSION

This paper reviews the possibilities to create more opportunities for people in general who want to start farming in open land and another prime idea to improvise and educate the existing traditional farmers to adopt smart farming. Innovative advances have sped up significantly, particularly with the appearance of the web and its executions in our day-by-day lives. We can perceive what innovation has meant for each space of human existence, including food, well-being, security, and innovation. Agribusiness are classified by the digitization of farmers worldwide and the ensuing information-driven cultivating brings about expanded utilization of current advances, for example, Farm observing contraptions like to give some examples, soil sensors, distant sensors. This paper is to understand about all existing researches done related to smart farming which leads to device a data driven innovative farming.

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