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SURVEY PAPER ON IT APPLICATIONS FOR AGRICULTURE MANAGEMENT: Enhancing Efficiency and Productivity

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ABSTRACT:

AIT, or agricultural information technology, has been widely used in all side of agriculture and has emerged as the most efficient method & tool for improving agricultural production as well as for fully using agricultural resources.

Utilizing Agriculture management of information technology, a significant AIT sub-technology, has a direct impact on the level of agricultural informatization and decision-making efficiency in agriculture. This paper provides an overview of the concept of agricultural information management, analyzes the characteristics of agricultural data, and goes into great detail about the architecture and designing process of Intelligent Agriculture MIS

KEYWORDS: AIT, RFID, Internet of Things, Wireless Sensor Network, Agriculture MIS

PREFACE:

The idea of "Digital Earth" was first presented by former US vice president Al Gore on January 31, 1998, at a speech at the California Science Center. Since then, the idea of a "Digital Earth" has generated a lot of interest and grown to become one of the newest areas of study for global science and technology. It has significantly quickened the pace at which digitization is developing across several industries. One of the key components of Digital Earth is Digital Agriculture, which is the application of the "Knowledge Economy," "Digital Earth," and "Information Superhighway" to the agricultural sector. It has been bringing about advancements in agricultural science, technology, and education as well as changes in agriculture management, production, and distribution. Informational or intelligent agriculture are other terms for digital agriculture. [1]

INTRODUCTION:

Agriculture in the twenty-first century will become high-quality, high-yield, pollution-free, water-saving, mechanized, and intelligent agriculture. Information in agriculture is a useful and essential tool. AIT technique, which serves as the foundational technology of contemporary agriculture, to achieve all of these goals. Utilizing information technology to digitize every step of the agricultural process—including crop cultivation, animal husbandry, the aquatic products industry, and forestry—is the essence of agriculture informationization. In order to integrate all the components of digital agriculture, an Agriculture Management Information System (AMIS) is needed. AMIS manages a variety of data formats, including proprietary and standardized ones, and it can exchange data with services that perform computation for digital agriculture. As of right now, AMIS has consistently raised their level. [2]

3.CHARACTERSTICS_OF_AGRICULTURAL_DATA:

AMIS is built on agricultural data, and the precision of the outcomes of farm information management would be directly impacted by the gathering and processing of agricultural data.
Farmland environments are extremely complex ecological systems that incorporate a wide range of aspects, from ecology to economics, from geography to society, and so on. As a result, gathering data typically require significant expenses and technology [3].

Location
Resource, ecology, and environment are examples of multisource spatial elements that are closely linked to agricultural output. Geographic information, sometimes referred to as spatial data or geospatial data, is information that pinpoints the precise location of boundaries and features on Earth, including oceans, built or natural objects, and more. Geographical data can be mapped and is typically stored as coordinates and topology.

Complexities

Both directly and indirectly connected aspects are included in the gathering and presentation of agricultural data. A variety of data types, including spatial and non-spatial data, images, and videos, are collected from various sources (such as on-board sensors, soil sampling, remote sensing, etc.). The task of comparing and analyzing disparate data must be completed prior to the management level. Therefore, in order to analyze the data and build classification, statistics, mapping, etc., it is first necessary to transfer the data from the collecting equipment to the analyzing computer. Subsequently, data must be transferred in the other manner once more in order to apply variable rates based on farmer requirements.

Movements

Crop handling usually involves several steps, from seeding to harvesting. The variables that affect crops are constantly shifting. For instance, a crop handling procedure might start at a farm where crucial elements of the crop production environment, like the availability of water and nutrients, frequently vary significantly over time and space within a single agricultural field. Aside from soil, other factors that might affect crop production spatially include diseases, weeds, pests, and past land management. Therefore, timely agricultural data collection is essential for increasing the precision of agricultural production management and decision-making. [4]

Dimension

Four categories of elements comprise every agricultural system overall: geographic, biological, environmental, technical, social, and economic. For instance, among the crops that fall under the biological factor category are wheat, cotton, corn, and paddy rice. Environmental elements that affect the growth of the same crop also include soil, fertilizer, moisture, sunshine, temperature, atmosphere, and other sub-factors. Thus, the collection and analysis of various mass data would be required for the entire AMIS, and this would directly determine the system's performance. [5]

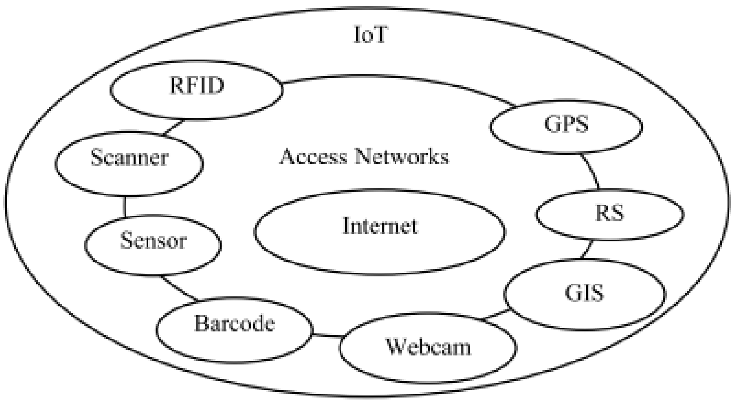

Figure 1. Concept Model of IoT

4.THE IoT CONCEPT:

Bill Gates first introduced the idea of a "thing to thing" connection in his 1995 book "The Road Ahead." In 1999, the Internet of Things (IoT) was publicly introduced when EPC global gathered together over 100 businesses to form the International Telecommunication Union. As per the ITU definition, the interconnectivity of things, humans, and things to things is the primary problem that the Internet of Things technology aims to tackle. The goal of the Internet of items (IoT) is to enable the sharing of information among worldwide items by combining various sensor devices (such as RFID, GPS, RS, and laser scanners) with networks . Millions of networked embedded devices, often known as smart things, can make up the Internet of Things;

This gadget has the ability to gather and transmit data about oneself, their surroundings, and related gadgets. [fig.1] [4] fig ref.[1]

5. TECHNOLOGICAL AND CONSTRUCTION STUDY OF THE SYSTEM:

The goal of agriculture MIS is to raise the standard of agricultural information processing and to promote more intelligent agricultural production management and decision-making. We can create the AMIS using a hierarchical structure based on the needs and features of agricultural production. Three layers make up the majority of this system: process, data analysis, data transfer, and data gathering (Fig2 ref [1]).

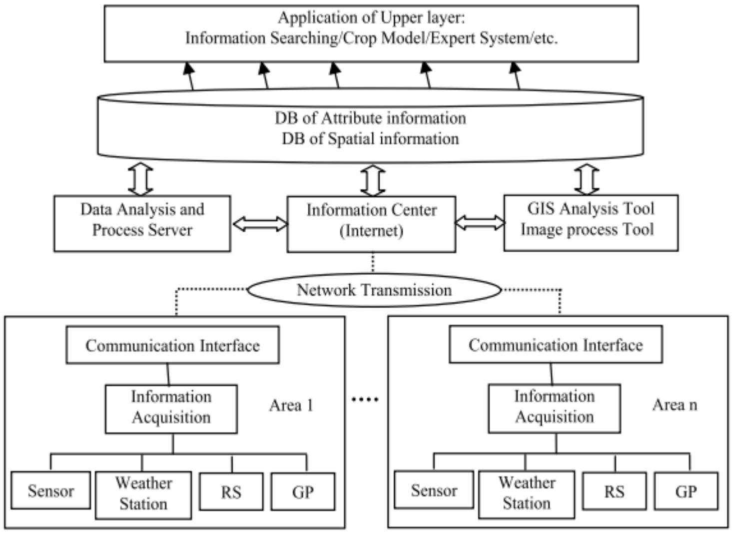

Figure 2. Architecture of System

A. Information Gathering

Data collection continues to be a difficult undertaking that has an immediate impact on the effectiveness and caliber of AMIS. The full potential of these data will become available when methods and technologies for gathering them that are appropriate are created in order to attain advantageous management practices. These days, as the Internet of Things (IoT) and its applications are studied in greater detail, the IoT is starting to take over as the primary means of gathering and transmitting data due to its qualities of dependable data transfer, intelligent functioning, and general sensing of information. Given the various stages and procedures involved in agricultural production, including crop growth, storage, and sale, we should use distinct technologies and methods for data collection in order to obtain more accurate data. [2]

1)Crop growth stages - Depending on the crop's growth attribute and the farmland's geographic characteristics, we can deploy various types of sensors to gather data on environmental factors like temperature, moisture, sunlight, fertilizer, and soil. Large-scale deployment, low maintenance, scalability, scenario adaptation, and other features are among the capabilities of sensors. It makes it possible to deploy actuation mechanisms and sensing systems with far greater automation and finer granularity than was previously conceivable. For instance, using data from the soil itself, the surrounding temperature, and other external factors, sensors and actuators can be utilized to accurately manage, for example, the amount of fertilizer in the soil. By using sensors to integrate feedback into the system, In order to obtain farmland's geographic information, The global positioning system (GPS) can be used to measure geographic location and offer information on where farmland's latitude, longitude, and altitude. Additionally, periodic land use, land cover, and other theme information are provided by airborne data collection systems using remote sensing (RS) technologies, such as satellite remote sensing and aerial photography .[5]

2) Stage of crop's storage and sell For tracking crop status, we should think of the ability of trace back and can query the database for information on identification/location of crop with specific attributes or characteristics, link to other spatial and non-spatial databases for identifying other attribute information associated with the crop, and identifying alternative sources of food and export safe crop when potential contamination or agro-bio-terrorism events occur (Fig3 ref[1]).

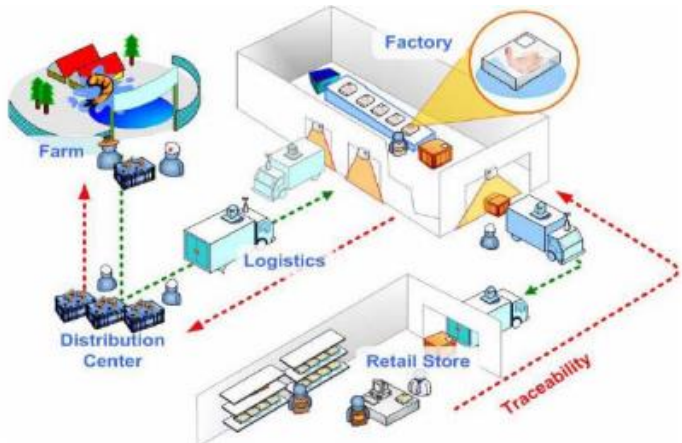

Figure 3. Track Back Flow of Crop

The radio-frequency identification (RFID) method in this process The primary element of the suggested crop tracking system is the tag. RFID technology will be to connect the supply chain at every stage, from the farm gate to the restaurant plate.

At the harvesting stage, several of these tags are placed in a crop container. Each tag is sized to roughly resemble the size of a single crop. The event's date, time, and place are programmed into the tags at each step of the crop handling process, along with any other pertinent information. such like the equipment's serial number, etc. As a result, all crop handling history is saved in the tags and is always detectable and identifiable by themselves. At any stage of crop processing, new tags can be added to the grain or taken out of the crop, depending on the situation.

B. Transfer of Data

This layer's primary duty is to guarantee the reliable transmission of data from the collecting layer, access the Internet via network infrastructure, including satellite communication networks, wireless sensor networks, GSM and TD-SCDMA mobile communications networks, etc. One of the best technologies for gathering data from the actual world is WSN. Consequently, WSNs must be connected to the Internet in order to publish contextual data in standardized formats for sharing with other entities. After this, the data must be analyzed, judgments must be made in remote locations, and the decisions must then be put into action using sensors back in the real world (Fig4). [5]

It is a demanding activity that can make use of complementing technologies[2]. Thanks to technological advancements, establishing wireless sensor networks to monitor various environmental phenomena, such as temperature, noise, and weather, has become comparatively effortless. There are numerous commercially available wireless communication nodes available, such as those from Lynx Technologies and different Bluetooth kits, such as the Cambridge Silicon Radio, CSR (Casira) devices .[4]

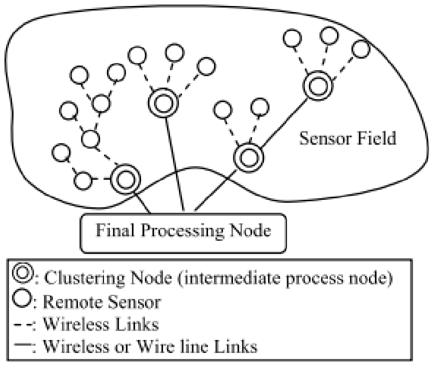

Figure 4. Typical sensor network arrangement

Fig ref [1]

C.Process_and_Information_Analysis I

GIS has shown to be a useful and efficient tool for spatial analysis and natural resource management when applied to spatial data. Within the field of geospatial information technology, GIS is a specific area that aids in the management, storage, and analysis of geographic reference data. Additionally, GIS is a tool that combines physical location and statistics to create relevant and instructive maps, graphs, and tables that may be utilized to make better decisions at various sizes [4].

Databases and data mining are the primary processing and analysis methods for non-spatial data. Data mining, also known as data or knowledge discovery, is the process of examining data from several angles and condensing it into information that can be utilized to boost sales, reduce expenses, or do both. Among the analytical tools available for data analysis is data mining software. It enables users to classify, evaluate, and summarize the relationships found in data from a wide range of perspectives or dimensions.

For instance, a Midwest supermarket chain examined regional purchasing trends by utilizing Oracle software's data mining feature.

Lastly, cloud computing technology has been employed to further increase the effectiveness of analysis and process. Cloud computing is web-based processing, in which shared resources, software, and data are made available to computers and other devices (like smart phones) via the Internet on demand. Using an intelligent cloud computing platform can guarantee that vast amounts of online data are instantly managed, processed, analyzed, and regulated. It can also build a dependable and effective decision-support system for top-level management and extensive industry applications. [5]

6. APPLICATION EXAMPLE:

When it comes to fertilization, the tractor/implement combination could keep track of what was being inserted into the hopper or tank by using sensors in the farmland and an identifier on the crops that could be automatically read. This information could be used to ensure that fertilizer combinations and application rates are both within recommended bounds.

Fertilizer knowledge, along with field, meteorological, and operator data, would enable automatic buffer zone width monitoring, guaranteeing compliance, and produce automated and comprehensive records of the day's fertilization operations. The information stored in the computer in a standard format would then be searchable by terminal customers via the Internet or a mobile device, and accessible to others farther down the food supply chain.

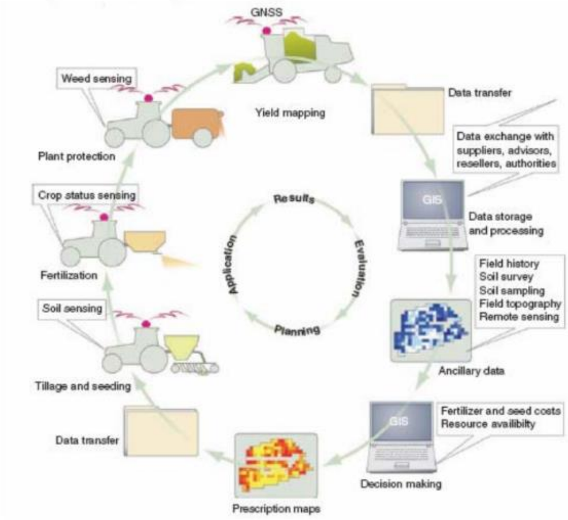

Figure 5. Exam of Agriculture Information Management Flow in Crop Production

7. CONCLUSION:

IOT-enabled devices forecast weather conditions by combining ML algorithms, satellite and drone imagery, temperature, precipitation, wind speed, and sun radiation data.

Analyze the sustainability of the crops and assess farms for pests, diseases, and poor plant nutrition. Using IOT Technology, farmers with Wi-Fi connectivity can get a customized farm plan. Farmers can meet the demand for more food supply and profitability globally by implementing IOT-driven solutions that increase output and income without depleting irreplaceable natural resources. IOT Technologies can be used by farmers to gain information in real time from their farms pointing regions in need of pesticide treatment, fertilization, or irrigation. Vertical agriculture is one example of an innovative farming technique that could help produce more food with less resources. Using herbicides (a substance that toxic to crops, used to destroy unwanted vegetation.) is reduced as a result, and considerable cost savings are realized along with enhanced earnings and better harvest quality. IOT technologies gather data on agriculture and high-resolution photographs from the air.

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