

Advance Agriculture Using Web and Mobile Technologies

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Abstract — As India is an Agriculture dominated country but still in this era of technology we mostly use only the traditional techniques for the increment of agriculture products. So to compete with the world we should also have to be using the recent technologies to increase the agriculture earnings. Such as by means of e-agriculture & m-agriculture we are able to provide better marketing facilities to both farmers and consumers or retailers to buy and sell the required farm products without the involvement of a middleman at its right profitable price which provides freedom of pricing and freedom of access. With the help of precision agriculture management system (PAMS) which uses sensors and modern advanced monitoring techniques to get land and crop data completely, correctly and timely it'll help farmers to make proper decision. By means of technology farmers are easily get to know about the information about whether forecast, new inventions which are going to help them for the betterment of agriculture.

Key Words — Agriculture, m-Agriculture, PAMS, sensors.

I. INTRODUCTION

In today's progressive era of mobile technology, the number of smartphone and tablet ownership continues to rise. We are moving towards SMARTness, then why agriculture remains as it is with the traditional one? Now it's time to move along with the time and apply the techniques by means of which we are able get more and more benefit from the agriculture. Now we should have to move towards the use of smart technologies in the field of agriculture. First of all we should have to provide market freedom to the farming communities so that they should get proper value to their products. To benefit the farming community from the new global market access opportunities, the internal agricultural marketing system in the country also needs to be integrated and strengthened. In particular, the market system has to be revitalized to:

- Provide incentives to farmer to produce more;
- Convey the changing needs of the consumers to the producers to enable production planning;
- Foster true competition among the market players.
- To enhance the share of farmers in the ultimate price of his agricultural produce.

Along with this the direct relationship and communication between the farmers and customers. With the world being more modern and technical oriented, smart phones has come into the hands of people even in the rural areas. Farmers have started to realize the importance of smart phones and technology. A Web cum mobile application will ease this problem.

With the market freedom we should also have to introduce the technique which can help the people from the farming community to make the proper decision for crop selection. It is possible with the precision agriculture. Precision agriculture is an agriculture management system which is based on information technology. It uses sensors and modern advanced monitoring techniques to get land and crop data completely, correctly and timely. With the analysis by GIS (Geography Information System), precision agriculture can help people to make the correct decision. It is an important part of digital agriculture and a good combination of the modern agriculture production methods and the newest high-tech techniques. Nowadays, the main techniques of precision agriculture are GPS (Global Positioning System), RS (Remote Sensing) and GIS. By these techniques, we can monitor the distribution of crops production, the composition of soil and its distribution, fertilize, seed, and spray reasonably, and reduce the operation costs, so that we can raise the production and economy benefit and reduce the environment pollution caused by abusing agricultural chemicals.

Nowadays, precision agriculture is applied widely in developed countries, while the integration technique is applied in the precision agriculture. Very first precision agriculture is introduced in US after that European countries have also carried out the research on precision agriculture and had a lot of practice. In Asia, the Japanese government launched the plan named "Agricultural Machinery Emergency Development Project In the 21st Century". Then South Korea and Malaysia also have conducted the same research. The main techniques are information acquisition, positioning technique, the monitoring of crops amount distribution and the logistics monitoring. However, the technique is still in the stage of research and perfecting. In addition, most of the application sites are large farms that will have a positive economic benefit.

II. LITERATURE REVIEW

We all might remember the 12th five-year plan, in which the 12th plan was designated to the field of agriculture for the development of our country depends on the Planning Commission and the Ministry of Agriculture to focus particularly on this aspect in the 12th plan. Modernization of (agricultural) marketing implies greater interaction and involvement of the private sector". In^[8] "It's obvious there is major block hole in the growth of the agricultural sector of India mainly because the farmers are held as hostages by the middlemen". Farmers don't get enough outcomes for the

efforts that they put in. Therefore, most of the farmers in Maharashtra commit suicide, a report says. To get out of this trap cuff, providing a direct link between the farmers and consumers will solve problems for both, thus yielding high profits. A web cum mobile technology will solve this problem. This will serve as a platform where they can communicate directly to buy/sell farm products at the right price.

The study in^[7] examines the cellular technology to enhance the services on Agricultural services and delivery system in India. The result of the research shows the amount and the quality of service with the speed in delivery is projected. Further the evaluation suggests that the farmer's benefits are more rather than the intervention from the better off. E- Agriculture^[6] is the rising field which focuses on the rural and agricultural development through the information and communication process. The E-Agriculture is the platform which supports the marketing of agriculture products.

III. CHALLENGES AND AWARENESS

There are several challenges involved in marketing of agricultural produce^[1]. There is limited access to the market information, literacy level among the farmers is low, multiple channels of distribution that eats away the pockets of both farmers and consumers. The government funding^[1] of farmers is still at nascent stage and most of the small farmers still depend on the local moneylenders who charge high rate of interest. There are too many vultures that eat away the benefits that the farmers are supposed to get.

Although we say that technology have improved but it has not gone to the rural levels as it is confined to urban areas alone. There are several loopholes in the present legislation and there is no organized and regulated marketing system for marketing the agricultural produce. The farmers have to face so many hardships and have to overcome several hurdles to get fair and just price for their sweat. The awareness on market information in general was found to be relatively poor in case of farmers as compared to the traders since the accessibility of market information in terms of communication systems is very poor in case of farmers. The status of assets on audio visual and communication systems of farmers clearly indicated that radio followed by television were the only assets owned by small farmers. The advanced communication systems like mobile phones were owned by medium and large farmers. A few large farmers also subscribed to agriculture magazines like *Krishi Jagran*, *Shetakari* and *Annadata*. However, traders with all the modern and advanced communication gadgets were able to source the market information easily and regularly.

The awareness on market information^[9] pertains to only arrivals and prices in local markets in all the categories of farmers. The other important production and marketing parameters like post-harvest handlings, grading and

standardization, etc. we're not known to the small and medium farmers but a few large farmers were aware of them.

Though, in India there are large numbers of farmers who have maximum farm size up to '5 acres'. Along with this lack of connectivity is also there^[3]. So implementation of PAM is not that much easy but not so impossible also. If a group of farmers comes together and take it seriously and wants to build the more precise agriculture system then it easy to implement the PAM. Alongside with this government also has to put some efforts from their side so that it will help to grow the ultimate production of farm products. Which will leads the share of agriculture in the growth of the country.

IV. THE ARCHITECTURE AND KEY TECHNIQUES OF PAMS

4.1 The System Framework of PAMS

PAMS uses 3S, Internet of Things, network and communication techniques as its system support, to collect the data of multi-source, multi-kind and multi-level. It is based on the unified spatial information infrastructure platform with Internet and Web GIS. PAMS will achieve the function of information management and decision making of the agriculture production process. PAMS should also include the spatial information infrastructure platform, Internet of Things infrastructure platform and agriculture production management platform^[2].

4.2 Key Techniques of PAMS

4.2.1 Internet of Things (IoT)

Internet of Things is called the third wave of world information production after the computer and Internet. It will be one of the most important productivity tools to promote the fast development of the world and bring huge economy profits. The concept of Internet of Things was first proposed in 1999. It uses information sensing equipment such as RFID (Radio Frequency Identification), SmartSense, global positioning system, laser scanners, and so on. According to the agreed protocol, IoT connects everything to Internet, changes the information, and communicates with each other so that it can recognize position, follow, monitor, and manage things intelligently.

Internet of Things has three characters. The first is total perception that receives data in real time and in any place by using RFID, sensor and two-dimension code technique; the second is reliable transfer of transferring data accurately in real time with the combination of telecommunications network and Internet; the third is smart processing that analyzes and processes the mass data and information to smart control things by using smart

computing techniques such as cloud computing, fuzzy recognition, and so on.

According to the above characteristics, Internet of Things is recognized as three levels in the industry (Figure 1). The bottom is the perceptual layer to perceived data; the second is the transfer layer to transfer data; the top is the application layer.

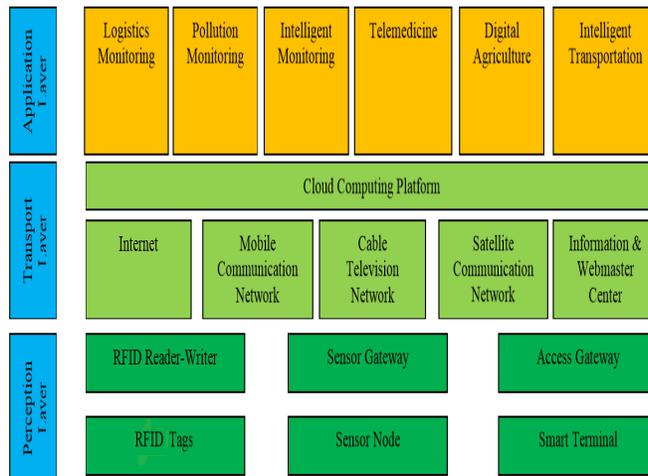


Figure1. The architecture of IoT

4.2.2 Web GIS

Web GIS is a very important milestone of GIS that marks its shift toward professional application to social application. It makes GIS no longer be limited to the desktop application but provides the ability for people – no matter who he is or what he does – to use GIS in real time and at any place. It has a very potential development future. Web GIS is a geography information system in a special environment based on the Internet technique, which is used to store, process, analyze, display and apply spatial data. In the Internet environment, the spatial data from every field and department of the society can be shared by GIS. What's more, Web GIS can efficiently get, store, process, analyze and display all kinds of geographic and spatial data to combine graphics and data well and display the corporation result of the research and analyze of spatial things in a direct and accurate way. It can better improve the efficiency of management, publication and research of spatial information^[2].

WebGIS uses the Client/Server concept to complete the analyzed work of GIS. It divides the work into the server side and client side. Client can request data, analyze tools, and modules from server side. Server can complete the request and transfer the result back to the client by the Internet, or transfer the data and analyze tools to the client. Figure 2 is the basic framework of WebGIS.

In PAMS, Web GIS has three main functions; the first is to provide a basic geography information platform for Internet of Things; the second is to provide a positioning

platform for Internet of Things; the last is to provide a mobile calculation platform for Internet of Things.

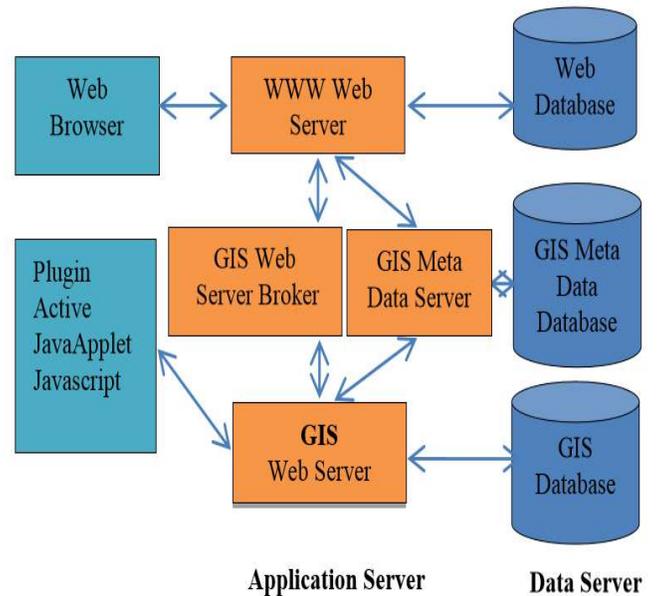


Figure2. The frame of WebGIS

4.2.3 Internet and Communication Technique

With the development of the new generation of communication, the techniques of Internet and mobile communication have had great progress. What's more, with the increasing construction of basic infrastructure, the increase of bandwidth and the speed of the transfer, all of the above guarantee the stability and efficiency of the Internet platform. In addition, the fourth generation communication technique based on WCDMA, CDMA2000, TD-SCDMA and WLAN can provide a broadband multi-media communication network platform, which provides the technique support and guarantee for the construction and completion of PAMS's infrastructure.

4.2.4 Location Based Service (LBS)

LBS is an information service for mobile objects, which is based on space geographic position by using GIS technique, mobile location technique and network communication technique in the mobile computing environment. Nowadays, the application of LBS has been rapidly developed and changed from the professional field to the social and commercial field. Many merchants started to use LBS to have a marketing campaign. It has a bright future. In PAMS, LBS are used to monitor the poultry and analyze their habits by position information to provide the decision support for the farm staff.

V. THE DESIGN OF PAMS

PAMS is designed for the large-scale agricultural production farm, which has a high information degree. We chose an ecology farm, which is situated in Huaihua, Hunan, China, as an example. We designed the system composition, function, operation flow, platform, and user interface and technique route. The goal of building PAMS is to provide a professional management system, which can provide functions including data collecting, data searching, data analyzing, production monitoring and managing, production process remote operating and production decision supporting by using advanced technique such as IoT technique, WebGIS technique, and communication technique as the integration support platform and integrating the multisource and heterogeneous data.

5.1 The Composition of PAMS

The system integrates and uses many advanced techniques such as data collecting, transferring and publishing. Internet and communicate network combine the work flow of agricultural production process to realize the high information of agricultural process. PAMS has following parts: the information infrastructure, database, local system, WebGIS, production management system and mobile client.

5.1.1 Information Infrastructure

Information Infrastructure is the construction and running foundation of PAMS. It includes computer network system, communication system, video surveillance and display system, image transmission system, sensor network system, and the device such as power source and machine room.

5.1.2 The Database Establishment

The database establishment is aimed to support the storage and management of spatial data. There are three databases: the local database, the GIS database, and the center database. We use data synchronism technique to sync the multi-source and heterogeneous data from the local system and network system.

5.1.3 The Local System

The local system establishment is centered on IoT. It collects the detail agricultural production data by many kinds of sensors and image collection devices. The data includes environment data, positioning data, and image data. We store the data in the local database by the local area network and transfer them to the center database by the synchronization method. Users can make different production plans individually to customize different areas. PAMS can reduce the cost of production by improving the utilization of chemical fertilizers and pesticides and improve

the crop yield and quality by reducing the amount of crop residues of toxic substances.

Additionally, the local system also includes remote monitoring and operation system so that the manager can remotely control farmland facilities in real-time and do the basic operation such as watering and adjusting the temperature. We then can realize the automation of agricultural production.

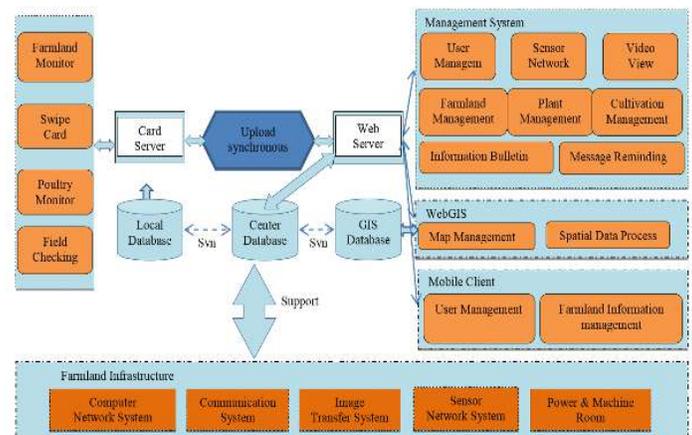


Figure3. The Composition of PAMS

5.1.4 WebGIS

Module WebGIS provides the function to collect, process, analyze and display farmland spatial data. Through WebGIS, we can manage the farmland spatial data and have the decision support.

5.1.5 The Mobile Client

With the improvement of tablet PC performance and mobile phone client and the increase of their operation functions, the mobile client of PAMS can help users to view the farmland information and deal with problems more conveniently. There are four mobile application types on the different mobile OS platforms (these operation systems are iPhone, Android, Windows Mobile and Symbian) so that different users who have different mobile phones can choose the right applications. The mobile client can provide the such as user management, farmland information view, submit and post information, and so on.

5.2 PAMS Functions

The main function of PAMS is monitoring and management, including:

- *Data collecting and processing*

To collect the real-time data of image and environment at agricultural production process through IoT, to store them at the local database and to sync them to the center database on time.

- **Video monitoring and display**
Monitor and display the farmland video through IoT.
- **Production management**
This function can introduce informatization to the agricultural production flow and management. The administrator can make the plan according the farmland information and specify a production person in charge.
- **Remote operation**
The user can remotely operate the farm device by PAMS to water and fertilize the farmland.
- **Information publishing and feedback**
PAMS can publish the production information and news in real-time and users can view different information under different permissions.

VI. MARKET SYSTEM SOLUTION

According to the current situation the market flow of the agriculture products is followed by some middleman because of those neither the farmers get the fair price to their product, nor customer get the satisfaction from the product for which they had paid. Diagrammatically current market flow of the agriculture products can be given as follows in the figure4.

So by the involvement of the middleman between the farmers and the consumers increase the price of the product and no one get the price satisfaction. So by the development of the system so that farmers and consumers get directly connected to each other will provide the price satisfaction for both the farmers and the consumer. The proposed system model provides the solution for seller buyer communication without involvement of the middleman. This concept was already thought by the Government of India known as DIGITAL INDIA, but still it didn't come into existence. But this system model will stand out differently as it will be customized into our regional language if needed. Further, more updates can be implemented into this play as a part of up-gradation process later. Let us have an insight on how products actually reach the customers, going through the hands of various middlemen and then to the customer or retailer which is clearly mention in the Figure4. So there is a huge gap of communication between the farmers and the

consumers. To fill out this gap of communication between the farmers and the consumers the system model is proposed which is as follows described as in the figure4.

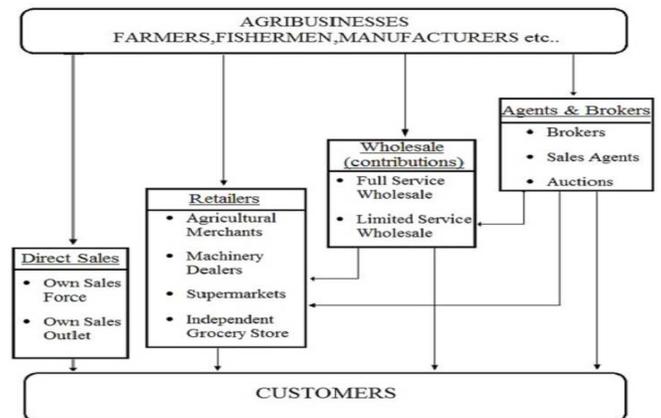


Figure 4: Flow of farm products from farmers to consumers (Actual)

Now as you can see the huge gap which has been filled and the communication between the farmers and the consumers have been made simple.

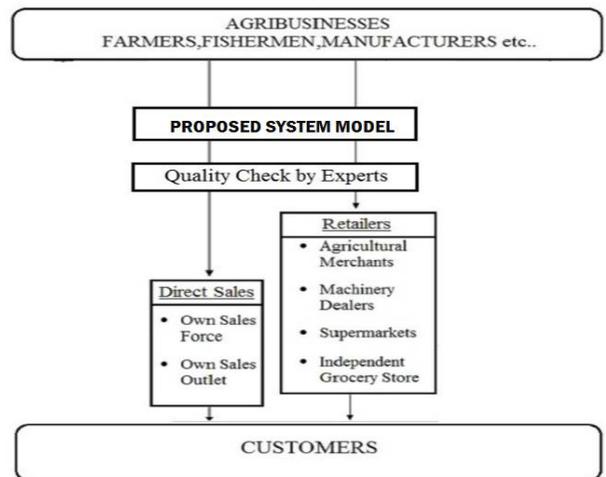


Figure5. Flow of Farm Products when Proposed System Model Is Used

There is a huge difference in the profit margin when this model is used and when not. Through this model we achieve our main objective, which is to increase the profit margin of the farmers and make sure they get the right price for their efforts.

VII. APPLICATIONS

- Reduce fertilizer costs.
- Reduce chemical application cost.
- Reduce pollution through poor use of chemicals.
- Improve crop yields.

- Provide better information for management decisions.
- Provide better farm records essential for sale and succession.
- Provides market freedom to both the farmers and consumer.
- Create direct communication between farmers and consumer.

CONCLUSION

There is no doubt that in any marketing there is a motive towards profit involved and at the same time the marketing is to be based on certain values, principles and philosophies such as offering just and fair prices to the farmers who toil hard to till. Bringing necessary reforms coupled with proper price discovery mechanism through regulated market system will help streamline and strengthen agricultural marketing. By means of PAMs the traditional agriculture is developing to the modern agriculture. Internet and IoT will play an important role in realizing this new technique change and providing a very unprecedented opportunity for the development of modern agriculture. PAMS is a complex system involving multiple processes and multiple systems.

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