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COMPARATIVE STUDY OF IOT TOOLS USED FOR CROP MONITORING IN SMART AGRICULTURE

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ABSTRACT

Agriculture plays a very important role in the development of Indian economy. Farmers if aware about their surroundings can contribute widely in the agricultural development. Many improvements and enhancement have been inculcated from past to help the farmers so that optimum utilisation of resources, maintaining the fertility of soil, temperature, humidity , efficient usage of power and irrigation methods, etc can be achieved. This may not only beneficial to the famers but also to the larger section of the rural poor who are directly , indirectly involved in agricultural activities as consumers. This will provide a excellent crop productive environment which facilitates the over all rural development. Beside them, this sector is also facing the crises of lack of man power and lack of water, which adversely affects the production of crops. Use of IoT devices is one of the solution one could find in this type of environment. This paper highlights the comparative study of all the available IoT tools to monitor production of crops. As IoT has already entered the agricultural domain, itshowcased efficient ways to increase and maintain thecropproduction, balanced prices of agricultural tools, herbicides, fertilizers etc. The use of IoT devices for agriculture especially for developing and monitoring crop production hasled to the collaborated environment necessary for the development of the economy as a whole.

Key words : *Sensors, Internet of things, modern agriculture, smart farming, digital farming, crop monitoring.*

As the population of the world is increasing with a rapid speed so the need to provender them is also growing. The years old techniques of doing farming is not sufficient to produce those extra grains. Besides old techniques, some natural and man made factors are also responsible for poor production. Natural factors cannot be removed but can be minimised if proper and timely measure are adopted, whereas man made barriers can be totally removed by using modern and scientific means of farming .Internet of Thing is one such domain which is getting pace and recognition worldwide in agriculture. IoT based devices are able to control the environment to a greater extent. Not only this they are trying to solve two biggest problems of farmers like lack of irrigation facilities and lack of man power which adversely affect the crop productions It is proved by many researchers that the use of machine has always reduced the labour of men. They help the farmers to keep a watch on the growth of the crops, timely spaying of fertilizers and pesticides, protection from wild animals and many uncountable numerous jobs.

With the modernization, the farming has become more structured and can be even planned in advanced, making the farmers as smart farmers. The farmers can not only test their soil fertility themselves but can grow crop according to the temperature , humidity , moisture of the soil thus making ideal utilization of land. Farmers are no longer considered to be uneducated whom any one can misuse for their personal gains. Today's farmers are well educated and can understand the benefit of using machine and technology in their farming. The use of digitization by the government are creating awareness and interest among the youth to adopt agriculture as their profession. Due to the flexible loan policies made by the government and creating retailers where expensive IoT devices could be available on low prices, efforts are made at both ends to improve the present agricultural scenario.

Timely researchers have proposed many algorithm and software framework which if implemented can yield better results in form of increased crops production. Production itself is not sufficient, it is associated with many other works like monitoring its growth, safeguarding it from wild animals, spraying of pesticides, fertilizers on them timely, removing the unwanted plants around them so that their growth may not get affected etc are all important. Many device been introduced as and when needed to fulfil the above mentioned tasks.

This research paper presents a comparative study of commonly available tools in the field of agriculture to increase crop productions. The paper also focuses the use of Internet of Things technology along with the need of cloud computing and Network technologies. The rest of the paper is organized as follows: In Section II, contribution made by researchers in the field of Internet of Things applied in Crop Monitoring is briefly reported, whereas in Section III, we present the Limitation of the mentioned works. Section IV presents Conclusion and Future Research Directions.

Contribution by the Researchers

The traditional means of agriculture are not sufficient in giving optimum results. Some of the farmers who have not accepted this digital change is agriculture have to still struggle due to geographical discrepancies, inadequate irrigation facilities, temperature, variation is soil, costly fertilizersetc. This create excessive depression among them, and when they don't get any type of help from anywhere they take drastic steps like committing suicide.

The use of IoT devices can be used to resolve these problems to greater extent .This technology is well equipped with sensors and other modern equipment which are connected with the server. The servers are used to keep large voluminous data which are made available to the farmers on regular basis through a well-defined network. Contribution of many researchers are appreciable in converting traditional agriculture to smart agriculture by using of IoT devices. These devices have reduced human intervention and human dependency to a greater extent. [3] Internet of Things technology generally creates an informative environment, thus trying to make agriculture digitize. [1]. In this digital world every one will be connected with each other and always ready to help each other.

It seems like farmers of twenty first century will be well aware of using all types of agricultural devices [1] A group of researchers headed by ManlioBacco have discussed various types agricultural equipment's in their research work. These equipment if used wisely may increase the crops yields. One such machine is Ariel Drones that are considered to be the most efficient agricultural equipment in land and crop monitoring.

Drones are very helpful is identifying uneven distribution of water, fertilizers, pesticides etc making the farmers aware all the time. They have also discussed the various available wireless technologies in their research work. Proper communication and information if given about these technologies to the farmers, they may make their living better and may contribute to economic development [1].

Researchers like Vijay andVishal[2] have proposed an intelligent monitoring platform framework to monitor the agriculture system based on IOT. The device was directly link to the smart phone. The use of smart phone have become very common as they are easily available at cheap prices and most likely easy to operate.The sensors used in the fields get directly connected with these phone, making the farmers aware and updated of every single action taken place in their farms. In this way farmers are always aware and updated with necessary information [1].

This framework requires less interaction and interference of human being thus creatingahuman less environment which is based on efficient use of technology to enhance the production conditions [3]. Self-operated machines may become advantageous in a condition where the young versatile generation are not showing interest to adopt farming as their profession. This a major threat to agriculture but can be minimised by using no man automated machines [3].

Production is all about growth of crops. But if the growth is not proper then it may not yields better results. The growth of the crop is directly related with the fertility of soil, time and evenly distribution of fertilizers, monitoring the plant, spraying of pesticides when needed, maintaining the moisture of land, adequate irrigation facilities etc [3]. Researcher like Anuja Chandgude have explained a crop monitoring system in their research paper.This tool may help the farmers to take decision relating to growth of crops [3].

In their proposed system Artificial Neural Network based algorithm is used to collect data. The sensed data is then compared with previous data. The farmer take the decision based on these comparisons. This system helps the farmers with prediction of any disease in the crops. It also supply remedial information and prevention measure, if undertaken may give good results [3].

Researcher like *H. Varma* have great contribution in making device that are predicting change in temperature and humidity of the surroundings. Change in climate creates confusion in the farmers about the type of crop production [4]. This device will help the farmer to provide irrigation facilities when need only, thus avoiding the unpredictability and uncertainty of producing crops. Also the time of irrigation can be determine. It will also calculate the amount of fertilizers need for that particular production and will automate the motor pump use for supplying water and fertilizer to the fields.

These IoT based devices issue awareness message based emails which are accessible by the farmers. This research work is highly appreciable as it informs the farmer that different crops require different level of water, fertilizer etc. for their growth. It also helps the farmers in doing rotation of crops [4].

Researchers like Carlos and Sandra has presented a multimedia framework which when applied to agriculture can give productive results. This frameworks use all the latest techniques along with IoT devices to assimilate smart irrigation system. They have made the entire framework on 868 MHz wireless mesh network. The aim of these researchers is to provide a hassle free

autonomous human intervention free decision making mechanism which is based on modern communication technologies and intelligent context service system [5].

This type of environment give control regarding production and monitoring of crop, thus in terms becomes a great benefit for irrigation and for saving energy andwater [5].

As it is rightly said that old is gold. It goes very well with some of the farmers who are quite rigid enough to follow the same old farming techniques and yet hoping for better results. The researchers like (6) have proposed mechanism" AGROTECH" named, to enhance traditional farming techniques. They have used modern wireless sensor network technology to promote rural agriculture [6].

The IoT based application keeps a track of various field activities like production, monitoring of crop, spraying of fertilizers, irrigation channels etc. this device provides real time updates through emails to the concerned person [6]. On the basis of moisture of soil the sensor activate the irrigation sprinklers or motor pump to moderate the effect of water scarceness by the observing the level of water sensor in the tank and also the temperature sensor [6]. This device sendssms in case of emergency and a generalised summary in form of report on user demand.

Various factors like soil fertility, moisture and humidity, adequate amount of fertilizer etc. yield good quality. [7] Researchers like Shruti and Rekha in their research work have engrossed the importance of quality of soil required for better production of crops. The traditional use of farming not incompetent leading to either excess or scarcity of everything right beginning from soil health to wastage of water, fertilizers, pesticides etc. They have proposed the use of cloud architecture to act as a server where real time data's are stored, making it available as and when required for decision making. [8]

They have used various types of sensors to capture real field data which are being analysed on MATLAB for optimum result [8]. They have used IoT based services to produce a network which will monitor the fields. Thelimitation of the traditional GPRS based system problems were reduced to a greater extent [8].

Researchers like MohanrajandKirthika has proposed an E Agriculture Application which will provide all the time information to the farmers. [9] Farming is not a one-time effort, it is an entire cycle which has to get started right from preparing the land for cultivation till the crops are ready for market. Therefore it is very essential for the farmers to be updated all the time with recent information.

Although IoT may prove advantageous in the field of agriculture, it is only possible with uninterrupted Internet speed. Getting access to Internet smoothly all the time is an important challenges generally faced by the user . Researchers like Kiran and Dr.Chhaya have explained the scope of IoT devices and their dependency on Internet for its survival [10]. According to them cloud architecture if used with IoT may prove beneficial in the field of agriculture.

LIMITATIONS

All the works describe above have some extent of limitation in their research areas which are listed as follows :

The researchers are not able to explain how deep learning techniques are useful in increasing production. A comparative implementation of Unnamed Ground Vehicles and Unnamed Ariel Vehicles in agriculture is missing. Due to lack of combine usage production will vary [1].

Various techniques and methods can only be used by the farmers if they are well educated and well aware about the usage. Incompleteknowledgeis generally harmful and may give reverse results [3]. Proper measure should be suggested to make them awared.

The research could be done on large number of parameters like abnormal weather conditions, bacterial or fungal growth on plants, range of pesticides to be used etc. In a country where more that 60% population depends on agriculture a wide range of feature are needed. Limited work may not give substantial results if applied beyond the set parameters [4].

A standard irrigation communication protocol needs to be developed which may be accepted widely [5]. System should be made secure to prevent data loss. Security is a major issue and should be well focused in advance before implementing the technologies.

Agriculture is one such domain where theoretical implemented is not successful unless it is practically implemented on fields. Farmers in India are suffered from natural calamities like inadequate rainfall. Majority of farmers are still depended on rainfall for their crop cultivation [6]. Some cheap efficient water management technology based system is needed in a developing country like India. the system should be intelligent to check all mention parameters and suggest the farmer the type of crop production.

Researchers can work in the areas of developing solar base IoT devices. These devices should use solar radiation through efficient wireless technology

to develop crop production and monitoring techniques [7].

Some cheap, easy to implement technology may be helpful to the farmer to a great extent to grow more food grins on the same piece of land. The researchers should spend more time in developing this type of technological devices [7].

Data mining techniques and predictive analysis is also an area where lot of work can be done to analyse the data generated from applied technology.[8] Self learning documentation can be added to help the farmers in decision making.

Besides mentioned many other aspects of agriculture are left unidentified which may contribute to effective production of crops. As the population is increasing and land covering agriculture is decreasing more efficient techniques needs to be implemented [9].

Youths needed to be motivated to make career in agriculture. Researchers should work in the field to generating employment means using agriculture [1].

Government and industries expert should come forward to solve the problem of uninterrupted Internet. The successful execution of every method, every framework, every protocol and every architecture is depended on the speed of internet [1].

Developing cheap devices may not be successful in qualifying security constrains. If servers are being used to maintain large amount of distributed data then security parameters should be planned well in advanced [4].

CONCLUSION

India's population is growing with a rapid speed and so is the volume of land is decreasing. More innovative methods should be made available to the farmers at minimized rates. Present scenarios is such that farmers are not well educated. This make the role of brokers very strong. Most of the farmers are depended on these brokers or middleman to get their work done. Government along with NGOs should play a vibrant role in making the farmers aware about their rights and duties.The farmers should also be given information about various agricultural activities like, identifying soil fertility and weather condition, techniques of sowing and reaping seeds according to soil types , fertilizer according to seed etc[4]. Besides this farmers should be given basic knowledge to access software technologies on smart phones.

More and more of farmers should be encouraged to attend more and more of government regulate camps on digitization of agriculture [4]. The farmers also faced theproblems of lack of availability of equipment. Heap devices but secure should be made available and proper rules should be implemented to minimize the use of middleman and anyone who tries to exploit the farmers. More and more of youths should be motivated to adopt agriculture as their profession so that we can build a productive environment for our upcoming generations.

Future Directions

The future scopes are to develop cheap secure devices. Researchers can contribute in developing some type of sensor based devices which are available at affordable rates. More research work can be done in this stream . Besides this security of data and networking devices is an interested area to work on. More rules should be framed by the Government to provide right markets to the farmers, removing the middleman who is generally benefitted by both the parties. More strict policies should be framed so that no farmers are being misguided.

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