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Smart Agriculture to Increase Farmers Profitability using Internet of Things

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Abstract

Objectives: To improvethe farmers' income through smart agriculture. **Methods/Statistical Analysis**: Farming is improved either by increasing the productivity or by reducing the cost. In this study, the cost incurred for fertilizers andpesticides are reduced by avoiding the wastage by using modern technology. Smart irrigation is also implemented to save water. **Findings:** IoT technologies using sensors helps to identify the correct crop requirements. If the fertilizers, pesticides and water are used according to the need of the crop, more uniform crop can be cultivated. We developed a method thereby the productivity of the crop can be improved. **Application/Improvements:** This method is implemented in the sugarcane field of Thondamuthur region. Around 15% of productivity is increased and 20% of profit of the farmer is also increased based on the utilization of right amount of resources.

Keywords: IoT, Irrigation, Productivity, Resources, Smart Farming

1. Introduction

The unavailability of farming land, global climate change and paucity of water are the main challenges of agriculture industry. The farmers need help to approach the potential of smart technologies to increase the productivity of their fields. The total productivity, growth rate of crops and nutrient level of soil are the essential features to increase the productions. The IoT tends the wide application of agriculture in mobile devices.The resource utilization should be increased to maintain the profits economically. The moisture level of crop decides the health status of crop. The requirement of water to the crop field varies according to the different weather conditions. The conversion of agricultural lands to non agricultural lands is also an important problem faced by all the farmers. Smart farming provides the accurate amount of resources at correct time. The irrigation of water increases the productivity and reduces the expenses.

Two specific ways to improve the Problems are:

1. Increase Productivity and Quality of Crop, and
2. Reduce Cost & Expenses.

The increased productivity and quality improves the benefits of agriculture. The following facilities are used to increase the productivity. The provision of transport facilities to long distance increases the production profit[1-3]. The implementation of smart irrigation ensures the high quality product. The loan facility strengthens the deployment of products in the market at right time. The suppliers frame the infrastructure as an attractive one to discover the consumers. The resources should be provided at right time to give proper quality. The awareness

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about agricultural education improves the farming lands for productivity. The primary factor of decreased productivity is different weather conditions. The crop fields should maintain the proper weather condition protection. The farmers and suppliers must select better seeds to improve the crop yield production. The modern technologies should be adopted for increasing high productivity and profits.

The farmers and suppliers create free cost of advertisements for the customers to get fresh items instantly using their mobile application. The faster money transactions enhance the consumers to make their payment as easier as possible. The Internet of Things connectivity enables the farmers to track the live status of their crop.

2. Literature Survey

In[1] proposed that the dynamic cloud is created in between clusters and base station. The base station is sending responses to the clusters requests. An aerial robot along with sensor is communicated through base station and clusters. This proposed system describes the limitations of wireless nodes in unlimited distances of field. The sensor nodes are involved in action to levy the viability of monitoring frost lands in spring season.

In[2] proposes a distributed data collection and monitoring of climate changes in field. The irrigation management is improved. The paper focuses on increased productivity and decreased cost. The particular area, kuttanad, has been taken to monitor the common difficulties.

In[3] focused on specific requirements of field and parameters of agriculture environment. Different sensors and their communication systems are analyzed frequently. The proposed system determines the review of all applications and present status of farming applications. This paper discusses the irrigation management, crop disease prediction and autonomous operation. The future work will enable the global wise farming system.

In[4] examined Plant color variation by the sensor node. The future agriculture system is developed with high capability of optical sensors. The controller is designed to detect the plant color change. The communication was enabled along with sensor nodes. The future system helps to improve the artificial neural network and new algorithms to detect the color change.

In[5] proposed the IOT smart agriculture to maintain the optimized usage of water and fertilizers. The system discussed with automated controlling techniques for an irrigation and manual smart mobile phone. The future work extends to the detection of animals in crop fields and prevention of cut down trees in the field. The automatic system is used to control the irrigation system with embedded design. The real time information is collected and processed by the small farming system.

In[6] focused on showing developments with potential application in real crop fields. The paper reviews the real applications of WSNs in crop field monitoring and discusses the use of this technology in agricultural meteorological networks. The sensor networks are used to collect the data regarding the performance of crop monitoring. The processing of data is used to enable the productivity, efficiency and profitability. The proposed system extends to waste pollution monitoring and nutrient management. Many international organizations are involved to improve the climate variability and data. The system will enhance changes in small scale organizations.

In[7] designed IOT sensor and cloud are to monitor the parameters of agriculture. Smart agriculture system is designed to promote the agriculture development and to realize the way to solve the issues in agricultural system. Soil moisture content is examined to measure the right level content usage of fertilizers in field. Overall production is improved due to the system implementation. This is used to reduce the adequate amount of water supplied to the crop.

In[8] proposed a system provides wireless potentiometry system to prefer the crops in field. The communication enhanced in between cloud server and mobile device. The disposable IoT gardening soil sheets are used to analyze the real time soil nitrate concentration during irrigation. This paper presents the gardening IoT sheets as a viable tool for in situ nitrate mapping. It is helpful to reduce excessive fertilizer application in everyday home and commercial applications.The analysis results provide increased productivity than other systems. The measurement of nitrate through cloud sever is transmitted to the end point.

In[9] concentrated on irrigation trip to improve the economic efficiency. An irrigation time table is used to maintain the different types of schedule foe different types of crops. The Zigbee System is designed to provide more flexibility in agricultural system using sensors. The low cost wireless system is used to control the irrigation. The waste management System plays a vital role by implementing using Zigbee system. The drip irrigation is enhanced with the activities of Zigbee. The modernized agriculture system was developed.

In[10] discussed about the parameters of yield's Humidity, temperature and soil handling. The addition parameters of wind speed and direction also mentioned with sensor activities. The monitoring system is reviewed by all factors. The automated control system was implemented to detect the disease prevention. The cost effective automated irrigation system is implemented with low cost. The future system proceeded with weather monitoring system.

In[11] examined the architecture to monitor the moisture content, humidity and temperature. In small agricultural farms the water consumption is reduced and productivity is developed using the sensor nodes. The report is generated to reveal the information about all small regions. The report is submitted to the end users for all types of crop scheduling in different climates. The future system extends to different types of hybrid IOT architectures based applications. The machine learning methods will be enabled with all technologies and energy efficiency will be improved by shortest path algorithms.

In[12] examined that the Precision Agriculture (PA) is a concept of integrating information technology in agriculture to increase the production and quality of the crops. The WSN is used to monitor the quality of pest and disease control, animal tracking and strength of the crop. They surveyed the importance of sensor in PA and the importance of WSN technologies for remote monitoring in the various applications of the agriculture field. The characteristics of sensors are implemented in soil and other weather conditions. Features and models in data transfer for communication are defined in well manner. Inproposed the latest technology which is used to reduce the cost and increase the productivity is called as smart agriculture. Uniform crops are produced using Precision agriculture. The data's are collected and processed to control the agricultural field. The basic parameters of agriculture are proposed to develop the communication nodes. The signals produced by the communication nodes are used to sense the moisture content. The development life cycle is created and communicated through central station.

In[13] examined Soil Health monitoring of different farming techniques with sensor nodes. The WSN plays an important role in finding all difficulties in crop fields. The sensor devices are manipulated to improve all aspects of yield to increase their performance. The dynamic forecasting is done to find their accuracy. The disease management also improved in an effective way to save the time and hard work of farmers.

In[14] reviewed the nutrient level of farming lands by advanced WSN technology. Due to this the productivity of farming is increased. The usage of fertilizers controlled by sensor nodes and it will be helpful to improve the soil content and moisture for well grown crops. The farmers can able to predict the sufficient water level for the crop growth. The WSN system is used to the time and resources for the farmers.

3. Smart Farming

Smart farming enhances more production in the field of agriculture. The agriculture plays an important role in the nation's economic part. Major part of our country depends on agriculture[4,5]. The loss of harvest leads to heavy financial saddle to all the people. The smart agriculture system reduces the losses during harvest and post harvest periods. The internet of things is used to develop the smart farming in all aspects. The proposed model consists of sensors to supervise the content of soil moisture[6]. The smart farming is also used to preserve the water resources and fertilizers.

The IoT and sensor technologies are used to implement the smart farming to fulfill the demand of food for the nation. The sensors are used to detect the health condition of soil and fertilizers. The mapping process is done by using sensors[7]. The measurement of fertilizers applied and other soil treatments are used to check the required areas for further processing in crop yield.

The GPS system also used to track and monitor the crop yield.The availability of fertilizers and pesticides improves the crop yield for better productivity. The awareness about the usage of fertilizers are used to avoid endanger of the environmental unbalance in the crop yield. The smart farming equipment along with remote sensing becomes more scientific to improve the productivity. The farmers are satisfied by their own progress in agriculture due to the adaptation of new technology. The potential risks are reasonable for the cost reduction of food. The main goals of smart farming discussed as follows:

- To achieve a proper plant growth by implementing new sensor technologies,
- Frequent updating of status of field and yield parameters,

- Analytics of better data collection to gather information,
- Optimizing cost and time,
- Record all the information for future reference, and
- Integration of software to improve the productivity.

The smart new technologies are implemented to improve the flexible application for all farmers and suppliers. The advantages of smart farming are as follows,

- Optimized productivity,
- Consumption of water and other resources,
- Efficient decision making using real time data,
- Improved quality productions, and
- Accuracy.

4. Proposed System

The productivity will be increased by managing different properties of soil, fertilizers and advanced pesticides. The smart farming decreases the cost of production. The proposed architecture is described in Figure 1. The architecture describes the productivity and soil nutrient management in smart farming. The high nutrient level of soil ensures the maintenance of quality of crop. The soil erosion leads to the lack of nutrient level in soil. The denoting of plants which are able to fix the nitrogen on soil should be used to increase the nitrogen level in soil. The farmers should avoid the planting of the same crop on the specific crop yield repeatedly. The proper way of testing on the elements of soil enhances the nutrient level to increase the production. The proper usage and follow-up of fertilizers will improve the nutrient level of soil. The planting of same species in the same crop yield will reduce the nutrient level of soil. The uniform crop develops the structure of root to increase the cultivation of crop yield. The uniform crop reduces the pressure to demand the high productivity. It increases the resistance to avoid the depletion of crop growth. This method will introduce on the floor as outdoor cultivation to enhance the agriculture.

The global food security demands the uniform crop to improve the pest and disease control.The over cost

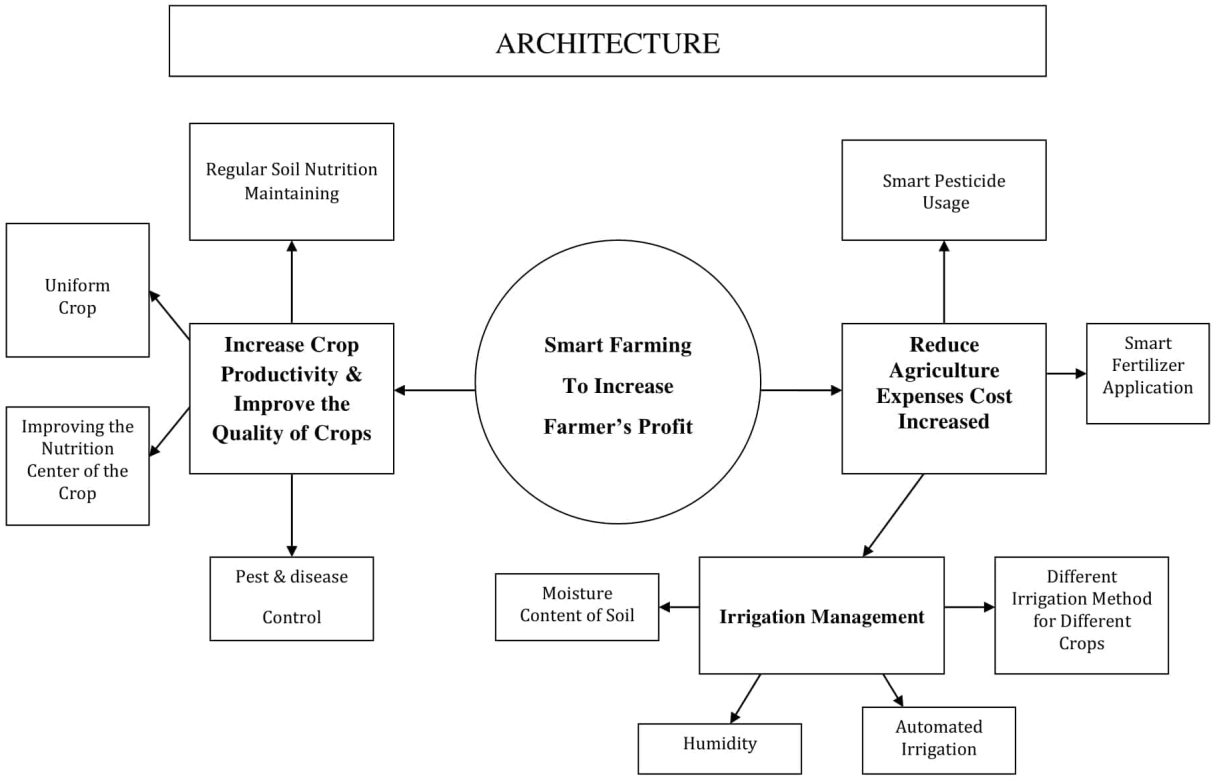

Figure 1. Proposed architecture of smart farming.

incurred for farming will reduce the profitability of the farmers. Some of the costs which can be reduced through smart agriculture are

- Smart Pesticide Usage, and
- Smart Fertilizer Application.

Smart pesticide usage define that the crops need pesticide to avoid yield reduction because of pest. The farmers need to predict and use the pesticide according to the need but the usage of pesticide is not optimum. Pesticides are over used and wasted. This can be avoided using the smart device which will monitor and use the pesticide according to the need of the crop. Fertilizer helps the farmers to get good quality hybrid crop. Over and under usage of fertilizer is actually happening. Smart IoT devices can be used to monitor the crop to identify the need of the fertilizer and accordingly it is used which will optimize the usage of fertilizer and reduce the cost.

The smart irrigation system directs to improve the productivity gradually. Crop irrigation is an art and should be properly done to reduce wastage of water. The research is done to do smart irrigation. The following method of proper irrigation will improve the farming and increase the productivity. Automated irrigation introduces the control of wastage water resources.In This paper the profitabilityand increased production is identified through the reduction of usage of farming resources at flexible manner.

5. Result and Discussion

The experiment is done in the sugarcane farming in Thondamuthur region in Tamil Nadu, India in the year of 2018. The main idea is to reduce the cost by utilizing needed fertilizers,pesticides and smart irrigation. Smart IoT devices are used in the field to identify the level of water, utilized fertilizers and pesticides. Once the threshold level is reached the usage is stopped. The Figure 2 shows the sugarcane productivity improved better because of right additively usage of resources .Smart utilization of resources helped to increase the profit and yielding. In Figure 3 the profit during the year of 2018 is 15% increased because of smart IoT device usage.

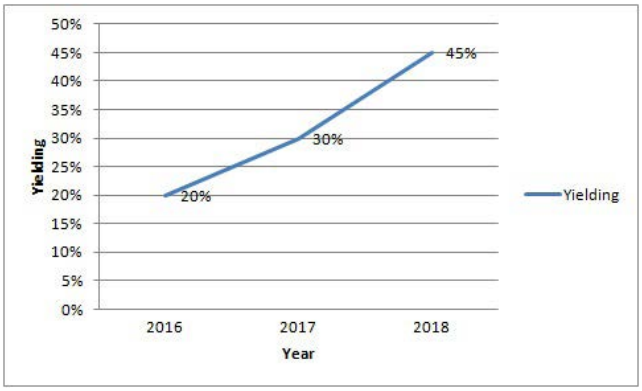

Figure 2. Comparison of yielding at different year.

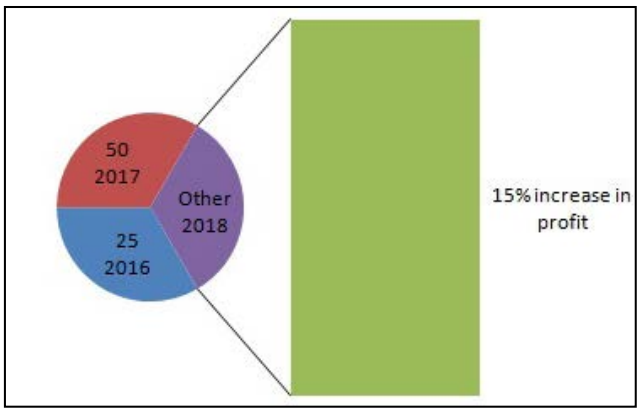

Figure 3. Comparison of profit during different harvest.

6. Conclusion

In this study we have proposed the smart farming architecture to improve the productivity of crop in the field. Te consecutive section of the paper represented the ways to reduce the cost and the way to increase the production. The experimental results have taken from the local region using sugarcane farming. The proposed architecture envisioned to be helpful for the growth of agriculture in future. The various surveys of existing reviews are useful to understand the deployment of agriculture using smart application.Future research depends on further improvement of factors associated with wireless sensor network in agriculture field.

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