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DEVELOPING A SMART IRRIGATION SYSTEM BY IMPLYING CLOUD SUPPORT IN CONJUNCTION WITH IOT

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ABSTRACT

Objective: This study presents a novel concept of an efficient and smart irrigation system for supporting the farmer's communities using an Internet of Things (IoT) and to overcome the loss from their cultivation a smart monitoring system is incorporated. Methods: This system is classified into two different phases. In first phase, the irrigation water storage tank will be controlled by the smart irrigation system. The level of the water is maintaining by the water level manger (sensor) and if the maximum level is decreased then it fills the water automatically with the support of the controller. However, this process is functioning under the approval of the farmer in every stage. The humidity of soil is observing based on the plants and the water will be supplied if it needs in the second phase. The decisions will be taken by the decision maker with the support of other co-devices and it has been monitored by the concern farmer and reported periodically in this process. In case, the soil threshold value is overcoming then the decision maker will be activated. The irrigation tank water level is maintaining perfectly by the proposed system without the farmer presences in the field and it is designed especially for managing discontinues electricity situation. Findings: The fault ratio is less than 1% and it occurs due to the device failures. The threshold value has been set based on the cultivated plants for maintaining the humidity of soil and it differs according the plants. The agri-cloud is providing the needed information at right time and it inculcates required nutrient for the high yields to the farmers. This system can be applied for all the plants. Application: Therefore, every farmer can be benefited from their cultivation, leads to save the cost, guides to get high yields, provides the platform for getting 100% of the profit without third parties participations offers an awareness and neediness for making an organic based cultivation and help to avoid the loss or failures.

1. INTRODUCTION

The production or cultivation of beneficial crops in the ecosystem which is produced by the farmers is known as agriculture. India is one of the agriculture oriented country and it has 69% of the people main occupation or side business is the agriculture. However, they are struggling a lot due to the labours cost and demand problems and facing the huge loss. As the result, they are winding up their agriculture work. The government is sponsoring many subsidy schemes, providing the high quality seeds and supplying the fertilizers based on their needs for encouraging and motivating the agriculturalist's business/work. On the other side, the technology is also providing the enormous supports and contributions for making the smart and automation system. The cost can be saved and the labors problems can be rectified as the outcome. The IoT is one of the fast growing technologies which will help the farmers with the support of the internet and it will make their daily or routine works in a smooth and easy manner. This paper presents the smart irrigations system with IOT for helping and supporting the farmers. In connection with that many researchers are developed various

smart agriculture systems. Linli Zhou and his coresearch workers have proposed an application which will support and facilitate the needs of the agriculturist. They were demanding that the proposed system providing high-quality, efficient, intensive, high-yield and ecological security agriculture1. Ojas Savale, Anup Managave, Deepika Ambekar and Sushmita Sathe have proposed an IoT concept which will supports the agriculture and agriculturists. The Wireless Sensor Network (WSN) in PA (Precision Agriculture) will improve the usage of the water, fertilizers while maximizing the yield of the crops and also will help in analyzing the weather conditions of the field2. Sheetal Israni, Harshal Meharkure and Parag Yelore have developed the smart monitoring system which is integrated with IoT and it monitors the soil moisture, soil temperature, and PH level of the soil by the sensors. As the conclusion of their work, this system will support the agriculture for the high yield process3.

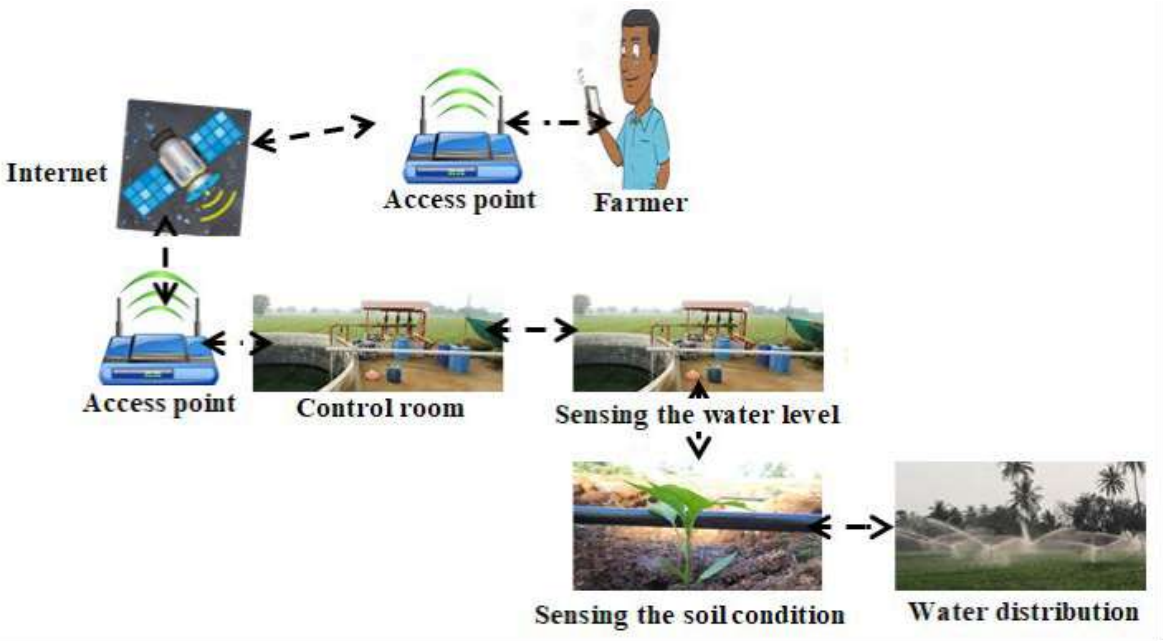

Figure 1. The Smart Irrigation System.

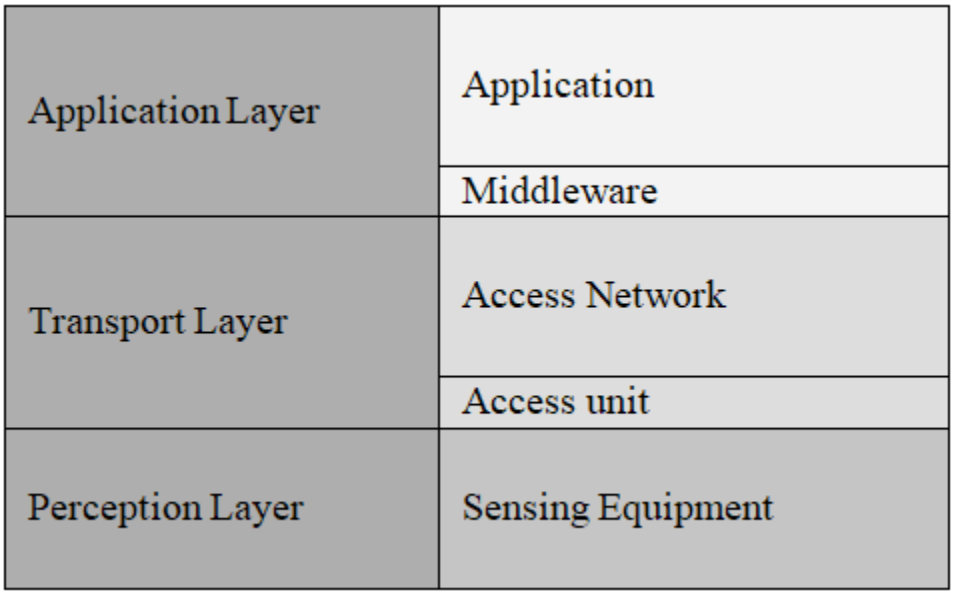

Figure 2. The architecture diagram of the agriculture in IoT.

Yong-Shin Kang, Il-Ha Park, Jongtae Rhee, and Yong- Han Lee have proposed a sensor-integrated RFID (Radio Frequency Identification) data repository-implementation model using MongoDB. They have shown that their proposed design is based on horizontal data partitioning and a compound shard key was one of the effective and efficient scheme for the IoT-generated RFI (Radio Frequency Identification)/Sensor big data4. Kala Fleming, Peninah Waweru, Muuo Wambua, Elizabeth Ondula, and Lianna Samuel are developed the frugal IOFT (Internet of Farm Things) which will improve for monitoring and organizing of the small-scale farms. The ultimate goal of their work is to bring the farmers more closely to the market and enhance the prospects for the food security in Africa5. Rajiv Ranjan, Lizhe Wang, Albert Y. Zomaya, Jie Tao, Prem Prakash Jayaraman and Dimitrios Georgakopoulos are presented an advance technique for processing and streaming the big data in the cloud data center6. Andreas Kamilaris and Andreas Pitsillides had presented the survey of the mobile phone computing and IoT. It has been given enormous information about the IoT contributions in the field of the smart system7. Md. Eshrat E Alahi, Li Xie, Subhas Mukhopadhyay and Lucy Burkitt are extended their research work on the design and development of a smart nitrate sensor for monitoring the nitrate concentration in the surface and groundwater8. Christopher Brewster, Ioanna Roussaki, Nikos Kalatzis, Kevin Doolin, and Keith Ellis have proposed an innovative concept which is supporting the agriculture and had mentioned the challenges and constraints in IoT. The sectorial and technological challenges are described for identifying a set of technological and agriculture requirements9. Many researchers are contributed their research work towards to the agriculture for the smart and efficient system as mentioned the above. This study proudly presents a smart agriculture system for supporting the agriculture activities and helping the farmer's community. It has been classified into seven sections. An introduction has been illustrated in the section one and the section two has been described the

proposed smart irrigation system and its need. The sections 3 and 4 are discussing the IoT in Agriculture and working procedure of smart irrigation system, the experimentation works are described in the section 5. Finally, the conclusion has been defined in the section 6.

2. THE SMART IRRIGATION SYSTEM AND ITS NEED

Every man needs healthy food to have a healthy life. The agriculturist is doing an important role in order to fulfil the needs of the human being. Now a day, many countries like India, China, USA and etc. are giving the immense support to the agriculture for cultivating food. However, the agriculturist/farmers are not getting high profit from it due to the hike of Labour, Maintenances and Fertilizer costs. It is one of the big problems among the farmers and many of them quit their work due these reasons. In connection with these issues, the government is doing the enormous supports to them for shorting out. Basically, the adequate water has to supply to the plants for the high-yields. But many farmers are failed to provide the sufficient water at right time due to the electricity problems and inadequate water source. To solve this problem, the irrigation water tank will be made by the famers and the water will be stored into it and it can be supplied to the plants based on the needs. Even though, they are facing a lot of problems due to the discontinuous electricity while filling the water into the irrigation tank. So, they have to work day and night for filling the irrigation water tank. There are some high venomous snakes in the field like India. Unfortunately, many farmers are facing the snake bite and many of them died while going to the field during the night time for filling the water. If, they are hired the labour for doing the same work, ultimately the cost of the labour is also high. To solve and support the farmer community this paper presents a smart irrigation and agriculture system without their physical presence over the field. It can be saved the agriculturist time, labour cost, high-yield compared than the traditional system. In addition to that, it provides a perfect platform for the cultivation system. Many authors have developed the smart agriculture system which help and fulfil the farmer needs. However, this paper presents a smart system which differs from others. The IoT, D2D (Device to Device), Micro controller, Sensors and Actuators, Communication, Operating System (OS), Applications, User Interface, Device Management (DM) and Execution Environment (EE) are doing the vital role in this research. The required devices and its configurations are listed below.

- ***Sensors and Actuators:*** The on-board sensors and actuators, or circuitry that allows them to be connected, sampled, conditioned, and controlled.
- ***Communication:*** The cellular, wireless, or wired for LAN and WAN communication are used for the device communication.
- ***Microcontroller:*** The 8 bits, 16 bits or 32-bits working memory and storage are considered and it can be varied based on the needs.
- ***Power Source:*** The fixed battery, energy harvesting or hybrid power source can be used for providing the power supply.
- ***Operating System (OS):*** The main-loop, event-based, real-time, or full-featured OS are considered.
- ***Applications:*** The simple sensor sampling or more advanced applications may be considered.
- ***User Interface:*** The display, buttons or other functions for the user interaction may use.

The overall structure of the proposed system is illustrated in Figure 1 and it is designed using the IoT concept. The main reason is that the farmers are using mobile devices so it's very easy to interact with the interfaces like sensors etc. This system is addressing the irrigation problems and solution for it.

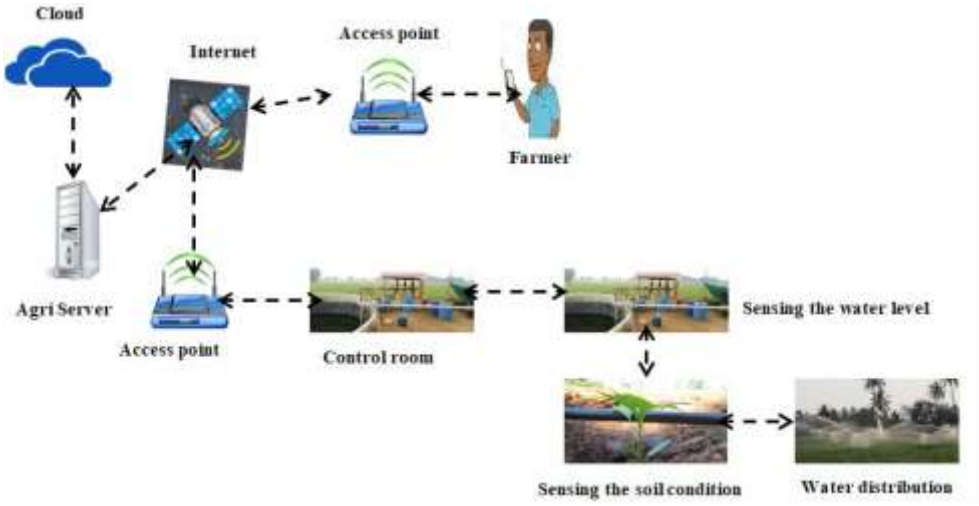

Figure 3. The smart irrigation with the cloud support.

Figure 4. The outcomes of the smart irrigation system.

3. THE IOT IN AGRICULTURE

The agricultural based IoT technology can be classified into three layers of the perception, transport and application. The perception layer is an in-charge for the data-aware acquisition, the transport layer is taking responsible for the acuity of data transmission and to sensing the data analysis, early warning, statistics, and scientific decision-making and automatic control the application layer is doing an important role. The architecture diagram of the agriculture in IoT has been illustrated in Figure 21.

3.1 The Information Perception and Acquisition

The information sensing technology of the agricultural is worried that the perception of intellect and computerization of information. It should be treated intelligently and transported through the wireless. It has high demand to the perception equipment and the perception. They have to enable an efficient determination of the objects, incessant and active of the features of the wireless sensing and transmission. This wireless sensing device needs to have the features of reliability, environmental adaptability, micro, intelligent and low cost. The IAT (Information aware technology) can be used for the incessant observing of the plant nutrients, the soil parameters and the dynamic of the environmental parameters.

3.2 The WSNs

Wireless sensor networks can be defined with the central base station, remote access node, network data server, wireless sensor nodes (SN), routing node and sink nodes. The SN is in-charge for collecting the various parameters of the humidity, air temperature, sunshine intensity, soil temperature, PH value, moisture from the soil environment and it sends the data to the sink node via a variety of means of communication.

4. THE WORKING PRINCIPLES OF TSIS

This section describes the overall working procedure (algorithm) of the smart irrigation system in step by step and it has been addressed the roles and responsibilities of the user and devices.

Algorithm -I
The sensor will observe the water level in the irrigation tank.
If the water level is not maximum
Then
{
The sensor and actuator are sending a request to get permission for filling the water in the irrigation tank via communication device.
{
If (
the concern farmer is given an approval for filling the water)
Then
{
The microcontroller will assist to run the water pump.
} If (
the power fails)
Then
{
The controller will be alerted till the power comes.
If (power comes)
Then
{
The water pump automatically will be started.
}}
Till the water level reaches maximum level, the step is to be continued.
}

Once the water reaches the maximum level the alert message will be sent to the user for stopping the process. End of the process. On the other side, the soil management sensor has been fixed. It helps to accrue the soil condition in terms of dryness. If the soil dries the sensor will send the indication to the user continuously. This dryness has been measured based on the threshold value and according to the plants. If the soil dryness has reached the given threshold value, the user will get the indication as well as request for supplying the needed water to the plants automatically. The controller will wait till the request being approved by the user. If it has been approved, then the water will be distributed to the plants. In addition to that, the maximum water level of the soil is set. If it reaches the maximum threshold value of the soil, then the water supply will be stopped

automatically and the work completion report will be sent to the user. The entire described system model has been illustrated in the Figure 1. There are authors have proposed many IoT concepts in agriculture. However, this paper presents an innovative idea to deal with day to day famers problems and fulfil their basic needs. Apart from that, it can be provided the specific and professional ideas about their cultivated plants. The new Agri-cloud has been incorporated in this work for sharing the information's among the agriculturist and it has been illustrated in the Figure 3.

Figure 5. The outcome of the smart water irrigation system.

5. EXPERIMENTATION AND BEFITS OF THE SYSTEM

This system is incorporated in India and the performances are observed sensibly. As the observation, the system is producing the best results and the farmer where the system has been installed is confident and happy on it. It's clearly defines that the achievements and contributions towards to the agriculture of the proposed system. The above mentioned devices like sensor, micro controller and etc. are doing a vital role for implementing this proposed system. This section is describing the opportunities which are provided by the proposed system for obtaining the high yields and more profits from their work and it has been illustrated in Figure 4. The following benefits are derived from the experimentation while using this proposed system by the farmers.

- The basic tips are provided based on the cultivated plants in their own language and it helps to make high-yields,
- It can be guided and motivated to adopt the organic based cultivation,
- It informs the day to day market status of their cultivation,
- It provides a plat form for avoiding the brokers or third party's involvements,
- It provides a way to get 100% profit without the third parties involvement,
- It is more optimistic and efficient,
- It is more users friendly.

The various developed smart water irrigation systems are showing in the Figure 5 and it can be assured that, 100% of the observation on the plants for making an efficient cultivation. Ultimately, the yields of the plants are increasing and it can be provided an opportunity to gain more profits from their work.

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6. CONCLUSION

This work was defined with the objectives of helping the farmers through the recent technologies by reducing their burdens, loss and enlarging the yields. In connection with that, the survey of their real problems had been undertaken and listed in the previous sections. The most important problem of the list is considered and it is addressed by the proposed smart water irrigation system for the high yield process. Though many sensors used the installation cost of the developed technology should be less. It is also being addressed. As the outcome of this work, it can support the farmer needs 100%, secure them from the loss, with cost less and gain more. In future, the best plants with high yield based on the soil condition will be suggested to the farmers through the technology which can help to gain more profit than the current cultivation system.