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Iot-Enabled Water Management For Improving The Crop Health In Smart Agriculture Farming

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ABSTRACT: Smart agriculture farming is the latest innovative technology in the agriculture field used in most developing countries. But all the places natural resources like water, soil, and quality of the land are not common due to the climate and organic elements presents in their land. For developing agriculture in those places water is the only resource to produce in the farming based on the quality of the water contaminants. Most of the places water quality is at a poor level due to the dissemination of the organics and chemical elements mixed in the water from the industries waste. Rainwater harvesting is also used for the development of agriculture but transforming that water to these places is a challenging task. For that, water management is the important scenario in agriculture to provide water to the plants in a correct proportionality of the contaminants. IoT-based water management is introduced in this research for finding the contaminants mixed in the water level and added nutrition whenever the quality is low. The water level given to the plant plays a vital role in agriculture if it goes high then the crop may be rotten. Nutrition level is not balanced in the water leads to affect the growth of the plant. To overcome this problem face by farmers in agriculture this research work proposed IoT-enabled water management for improving crop health in smart agriculture farming. This research work disseminates the water and nutrition to the plants continuously but the only limited amount will be delivered at a stipulated interval of time.

1. INTRODUCTION

Smart agriculture farming an innovative technique for the farmers and it will help them directly in the cultivation process gaining huge yield successfully. There are some classic approaches used in the farming process but IoT-based smart farming helps the farmers to

increase their economy and productivity. All possible strategies are worked out in farming, with the help of natural resources contribution in the agriculture land. The minerals, fertilizers, and nutrition of their land soil are good then the cultivation process could be more effective among all other farmers [1]. Similarly, water is also a natural resource that provided an inevitable contribution to the agriculture field for their livelihood implementation. Water contaminants presence is going very low due to industry wastages mixed into river water and lake [2-5]. To perform the wastewater treatment process heavy investment and equipment have been used will not suitable for normal small-scale farmers [6-8]. IoT sensors are used in this water treatment process and monitoring the minerals level presence continuously. For water treatment purposes, a separate unit will be configuring to manage all sources of water from different places. It will help to agriculture field to increase crop health and quality in a huge level of productivity [9-11].
The following figure 1 apparently shown the water consumption used as global level.

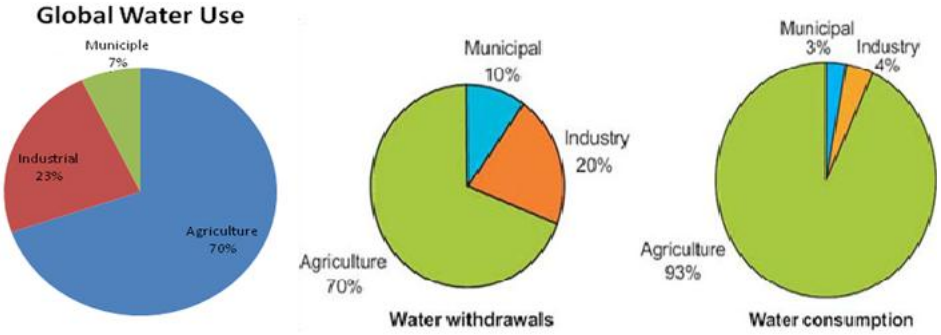

Figure 1: Water usage and consumption in world level

2. RELATED WORKS

Smart Agriculture Farming was introduced as an emerging technology in the Agri field, to procure more crops and yields in a quick time. Moreover, the monitoring and controlling process has been done by IoT framework with cloud storage. The minerals and contaminants present in natural water resource is not constant value in all land of the farmers. To make efficient about this water management, water treatment has considered for purifying or recycling the water from the sources. More resources are providing water to the farmers for their land but the minerals added in the water for cultivation is varied depending on the farmer's economy [12-15]. Small scale customers and village peoples are not ready to spend more amount for water treatment and minerals adding procedure. In that situation, industries and Agri companies are taking initiative to produce water treatment plans and separate units to do water contaminants maintenance using the IoT framework [16-18]. These frameworks help to control and monitor the contaminants percentage in the water while doing farming process and inform the disaster or loss of minerals in the water to the centralized controller. All type of development has been done in the water management process to improve the crop health in the land as well as cultivation time also. Optimization principles helped in this process for minimizing the cost of the entire principal to do.

3. PROPOSED ARCHITECTURE

The proposed architecture contains three units to do the water management process in a single processing method. They are water resources from the ground, rain, dug well; bore well, river water, and storage water. Next IoT sensors are used to detect the water levels and

contaminants present on that such as pH Chlorine, Oxygen contents. The water distribution unit is the deciding part that delivers the water with minerals and full contaminants to the farmers' land. All connections made with PVC pipes in the respective units and power will be given to each separately. Water resources collected from sources and checked with minerals initially then distributed to the lands with the help of a water pump motor through solenoid valves. Any leakage in the pipes can detect using the IoT framework and all data must be stored in mobile app and cloud storage for analytics. The following figure 2 illustrates the architecture of water management.

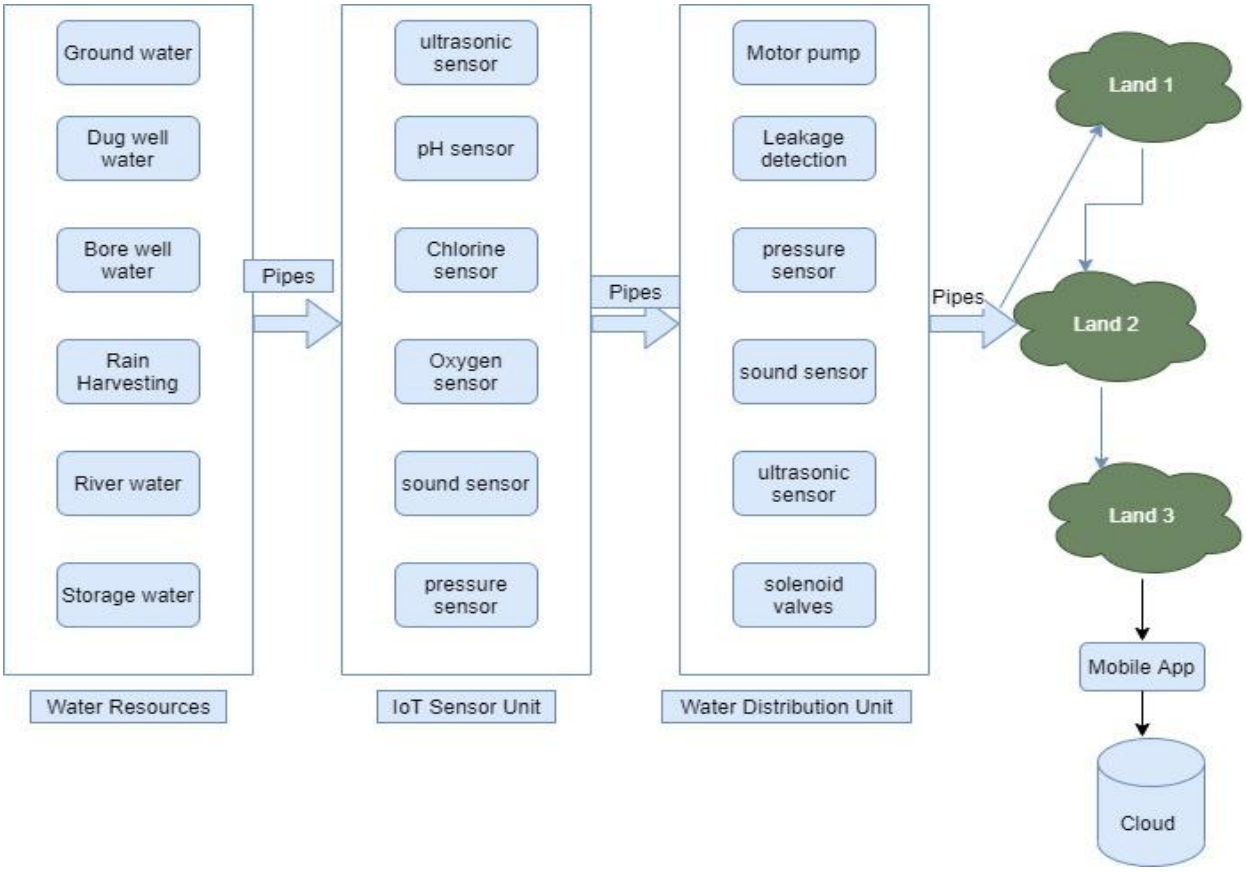

Figure 2: Proposed Architecture for Water management

In this architecture, several sensors are used to detect the minerals and contaminants present in the water such as an oxygen sensor, chlorine sensor, pH sensor**.** A sound and pressure sensor is used to control the pressure and watch the sounds coming from water sources since the volume of the water is high. A microcontroller acts as a centralized controller unit and Nodemcu is used to make connectivity between devices and controller vice versa. The ultrasonic sensor is used to find the water level in all units and solenoid valves are connected for releasing water at a minimum level if required. GSM unit is used to send notifications of the entire unit from the controller to the users. The mobile application has been developed for storing all the values and once it will be accessed then be transferred to cloud storage for analytics. The following table 1 is listed out all the sensors and their purposes used in this system.

Table 1: Sensors used in water management

S No	Sensors used	Purpose
1	Arduino	centralized controller
2	Oxygen sensor	Levels of oxygen in water
4	Chlorine sensor	Calculate the chlorine in water
5	Sound sensor	Measure sounds in pipe
6	Pressure sensor	Calculate the pressure in pipes
7	Nodemcu	For connectivity
8	pH sensor	For water purity level
9	Mobil app	Store land details
10	GSM module	Notifications sent
11	Ultrasonic sensor	Measure water levels
12	Solenoid valve	Provide limited water level
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4. RESULTS AND DISCUSSION

Since the sensors and units managed heavily this experiment has taken in a testbed and their results have been taken into considerations. The main testing part has processed the minerals percentage in the water and the contaminants used. It is varied based on the sources of water collected from various places located. The samples of water taken from all sources and tested with our experiments it has shown rainwater contaminants are good when compared with all other sources. The following table 2 illustrates the levels of minerals present in all types of water.

Table 2: Minerals present in water sources

Land details	Water quality in distribution unit	Water Management

	pH	Chlorine	Oxygen	Pressure	Sound	Pressure	Minerals	Water level
Land 1	4.7	7.1	7.2	9.9	5	7.5	7.9	9.3
Land 2	3.7	7	6.7	9.1	4	7.2	7.2	8.9
Land 3	5.8	7.8	7.2	8.9	6	8	8.2	8.5
Land 4	3.1	6.9	6	6.2	3.5	7	6.7	9.3

The percentage of minerals in the water different in each source and the same will create more impact on various lands. The soil quality differs in each land so that the water contaminants presence is making big changes in the crop health of the land. All the lands are utilizing the same content of water every second but the crops improvement depends on the soil quality level used in each land will decide at the time of cultivation. As much as possible the minerals will be added to the water-based on the water quality and soil quality has been checked before the cultivation process will improve the efficiency. The following figure 3 explains the mineral levels used in water and the usage by the different land.

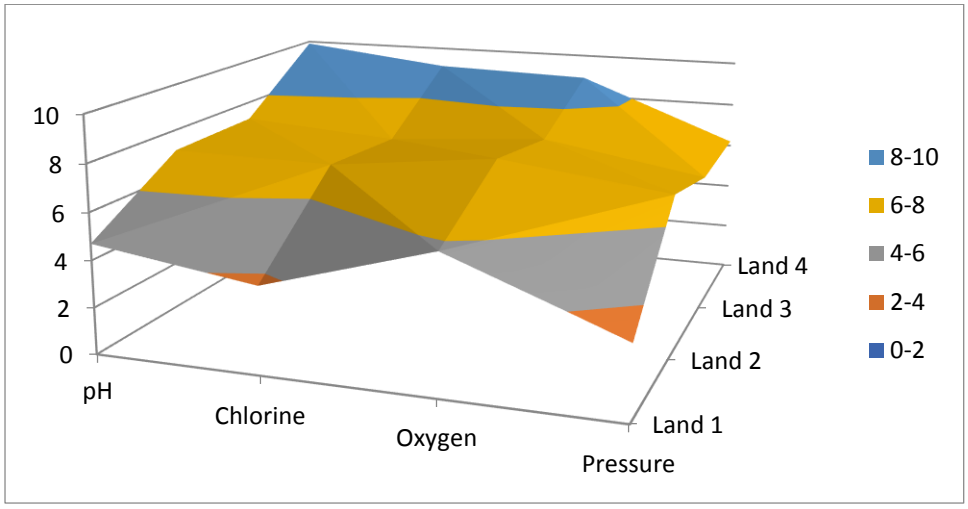

Figure 3: Minerals levels used in lands

The water level is decreased in the water distribution unit it will be immediately noted with the help of ultrasonic sensors used in that unit. The water source level is also checked immediately and if any water source is not working means another source unit will provide the water continuously without any problem. So the entire unit is working continuously and monitored with the help of IoT sensors with the framework. Mobile app data viewed by the users and come to know the threshold level of water said in the controller unit. Notifications are sent to the users continuously by the GSM unit working in the controller unit to the respective persons. The pressure sensors are used to predict the pressure in the pipes of the

water distribution units to handle them in critical situations even their pressure levels are low. The following figure 4 and 5 explains the usage of water pressure and levels in the different lands

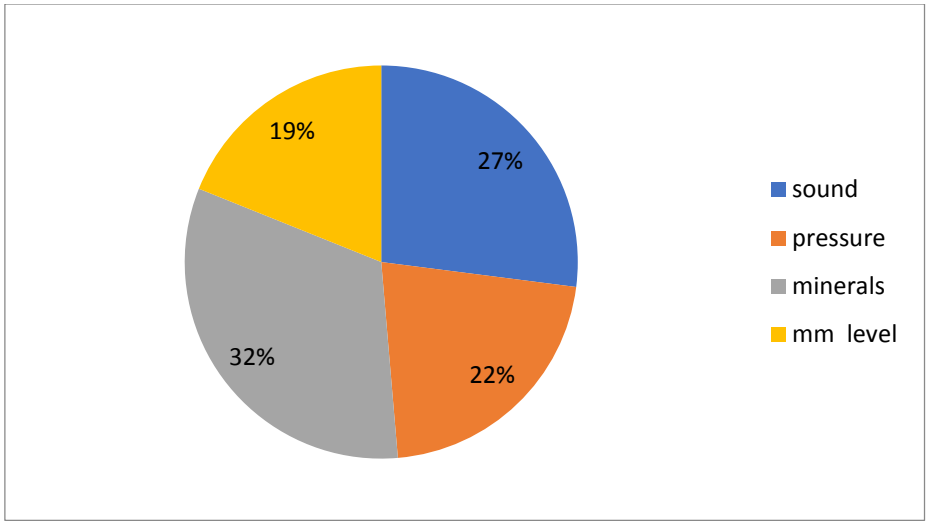

Figure 4: Factors used in land as percentage wise

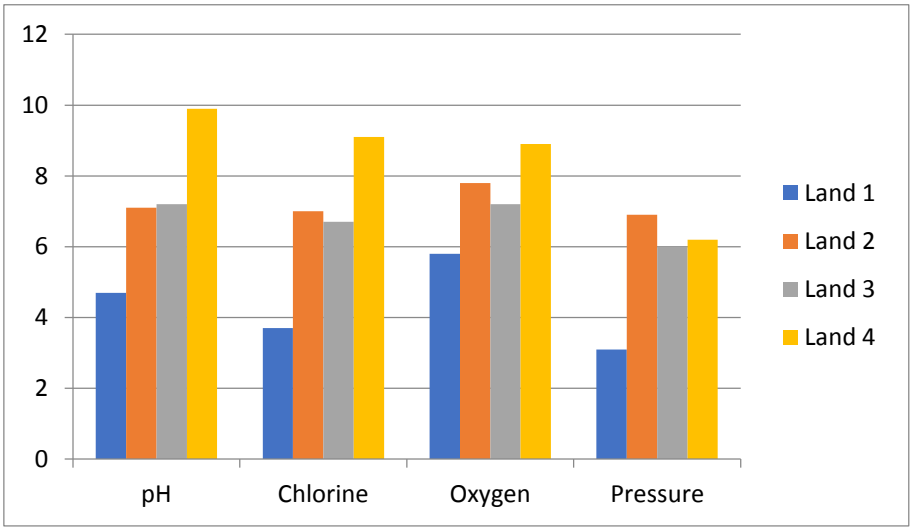

Figure 5: Pressure and minerals used in land

At last, the pipes which are connected between the different lands are controlled by the IoT framework continuously to avoid the heavy flow issue. The leakage problem is also handled with the same IoT sensors, if any leakage is there immediately it will stop the flow in the pipes through solenoid valves. This will reduce the disasters that happened in water management effectively. The pressure handled in pipes and sounds is always predicted with the help of previous values captured in mobile app and cloud storage. The analytics done in cloud storage using modern tools are predicted the disasters that happened between the pipes connected in the water management technique. If the pipes are not strong will leads to cracks in the pipes and automatically leakage of water is insisted to the units. One unit will affect by this cracking problem immediately the entire unit will be stopped by the centralized controller as an emergency action taken from the controller unit. The entire unit is controlled with an IoT framework only for the benefit of avoiding disaster and leakage is happened on

the pipes. It differed in each pipe because the pressure and sound in every pipe are handled at various time. All the lands are procuring water, not at the same time but getting it from the water distribution unit whenever required. The following figure 6 will illustrate the pressure and sounds handled in pipes during the water treatment processes.

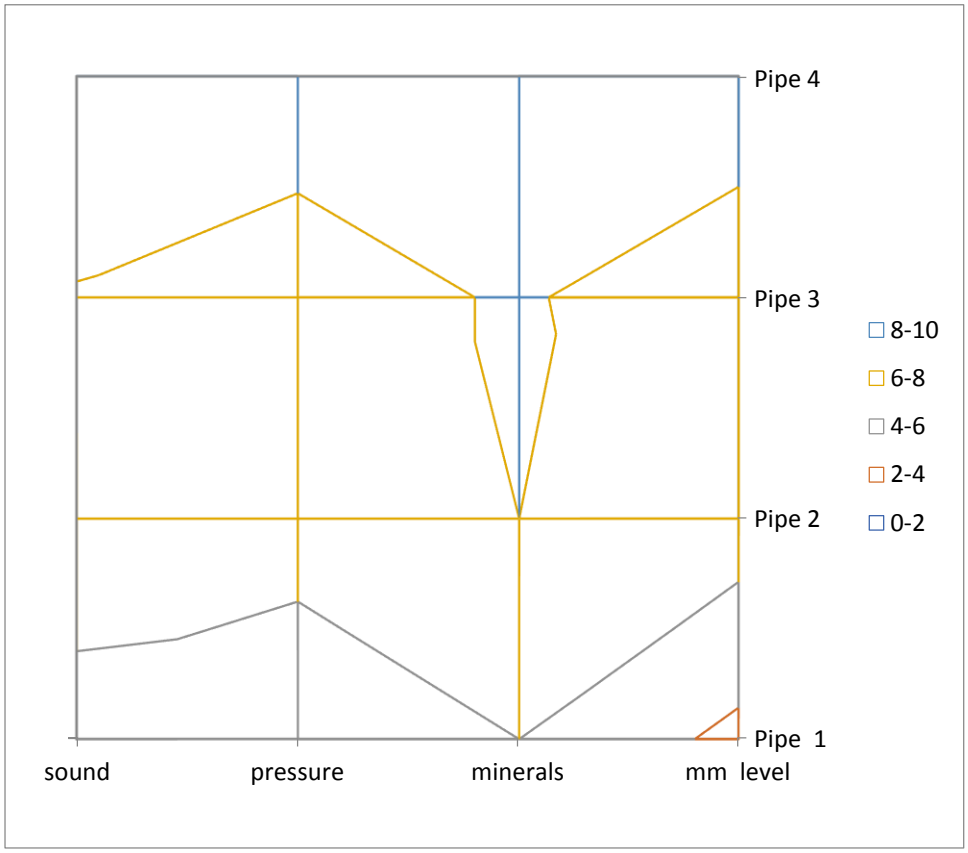

Figure 6: Water pressure and sounds range in pipes.

5. CONCLUSION

The Water Management in smart agriculture farming for the development of crop health was developed and tested in a testbed for collecting data as output results. It is visualized using the modern tools available for cloud and big data platforms in different aspects. There must be a centralized controller is used to monitor all the activities of this system by IoT framework. The water distribution unit helps this approach to deliver the water in a proper time and level to the testbed for crop health improvement. The total environment has been settled up in an IoT framework for easy monitoring and controlling purposes. It is used to avoid disaster and water leakage problems in the water management process effectively. Also, the water treatment procedure is used to recycling the wastewater from the industries and companies. Water contents like minerals and contaminants have been watched closely about their levels used by the various lands if any discrepancies will be removed immediately in this system. Suppose water leakage between the pipes is created a major problem from the water distribution unit will also be rectified and solved using pressure and sound sensors present in the units. Water management technique is used as the best solution to increase the

productivity of the crops to help the crop health monitoring on various types of lands. It will give lead the small-scale farmer's economy to the highest level within their usage limits.

6. FUTURE ENHANCEMENT

IoT-Enabled Water Management for Improving Crop Health in Smart Agriculture Farming technique is used in major countries to improve the livelihood of the farmers in the society. It will be very helpful to the industry and companies who are working in the agriculture field to improve the backbone of all nations in the world. As this experimental testbed was given the best and accurate results using this system further it will be developed in open land or big place of land vice versa. Handling of all units used IoT sensors will be increased in the future to deliver the crops more in count [19-20]. Since the unit sensors and wireless networks have created huge data in real time cloud computing is not the only solution to store all in real-time. So big data is used to store such huge volume data and will do analytics for other purposes [21, 22]. This system will approach a lot of government organizations to recycle the water wastages from the different sources available in the nations. Water management technique is helping in improving the crop health in the smart farming field effectively to get accurate results during the cultivation time and gaining a lot of yields in future.

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