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Smart Irrigation Optimum Utilization of Resources - Future Needs

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***Abstract*— An effective management of ground water in all aspects is very important nowadays. We have proposed a WSN aspect to tie up agriculture field with the technology. So later on we can this system as an example of interdisciplinary approach. WSN with an approach of priority driven scheduling in garden is proposed. Smart irrigation is the new trend now a days and it is the major requirement due to many critical factors such as irregularity of monsoon, less availability of water etc. We are observing the irregular nature of monsoon nowadays. Though sufficient ground water is available still we have to make sure it is good to use for better yielding of crops, few factors such as temperature, humidity, air flow, soil moisture plays an important roles in better crop yielding. Development in this field is snatching the opportunity to design and integrate more additional functions and services in future. In this proposed idea we are presenting irrigation system for a smart home garden (by creating different test beds for different soil structures) which can be integrated with existing smart home irrigation systems and obviously can be extended to large filed too. In this proposed system there will be few slave nodes and master nodes each of which will be equipped with a microcontroller.**

***Keywords*— Wireless Irrigation System, x-bee, DHT 11, Priority Driven Scheduling, Controller, Smart Irrigation**

I. INTRODUCTION

A report from NAPCC states that India has also revisited the National Missions under the NAPCC in the light of new scientific information and technological advances and identified new missions or programs on wind energy, health, waste to energy, and coastal areas. It is also redesigning the National Water Mission and National Mission on Sustainable Agriculture. [17] Therefore we can say that in future steps will be initiated by the governments to preserve and effectively utilize the natural resources. Monsoon, meaning season, is the wind system over India and adjoining oceanic regions that blows from the southwest half the year and from the northeast during the other half.

The winter monsoon or the northeast monsoon brings rainfall to the southeastern part of India through north easterlies during October to December and contributes a small percentage to the annual Indian rainfall. [16]

"Water" is tonic of life to survive and all developmental activities require water, it may be an agriculture sector or industrial purpose and even human being totally depends upon the water. As day to day population is increasing which consumes huge amount of water and for agriculture and gardening too water is being consumed at highest level. Water as a resource available either as surface water which is very less due to irregularity of monsoon and groundwater which is day by day reducing. Government reports states that groundwater availability and movement varies region wise and temporally and it is also non-uniform. Thus, the strategy for sustainable development and management becomes a challenging task. We have initiated a scheme to tie up technology with the agriculture field. Since last few years huge problem occurred due to monsoon's irregular behavior and ground water level is reduced. People faced many problems even for drinking water and therefore question raised about the farming. As farming (agriculture and gardening) plants require more water so we have proposed an idea to tackle with this type of situation. We have proposed an interdisciplinary system by combining wireless sensor networks and agriculture sector.

II. PROPOSED SYSTEM

Wireless sensor networks (WSN) is nothing but a spatially distributed autonomous sensors nodes to monitor physical or environmental conditions, such as temperature, sound, pressure, moisture, humidity etc. and to cooperatively pass their collected data through the network to a main location i.e. master node.

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Figure 1 Basic Communication of WSN

A Wireless Sensor Network consists of multiple detection stations called as sensor nodes (slave nodes), each of which is small, lightweight and portable (vary with the application). Every sensor node can be equipped with a transducer, microcomputer, transceiver and power source. The use of transducer is to generate the electrical signals based on sensed physical effects. The microcomputer i.e. master node processes and stores the sensor output. The transceiver receives commands from a central computer i.e. either control panel or master node that is taking care of all the sensor nodes.

2.1 Effective Irrigation

Use of proper method of irrigation is important because of irregular monsoon and less availability of ground water for agriculture and gardening. The advantage of using this method is to reduce human intervention and to ensure proper irrigation. Important aspect is to save the natural resources.

Figure 2 WSN Irrigation

Recent technological improvements have made the deployment of small, inexpensive, low-power, distributed devices, which are capable of local processing and wireless communication, a reality.

Such nodes are called as sensor nodes (slave nodes). Slave nodes coordinated with the information from a large number of other nodes, they have the ability to measure a given physical environment in great detail. Thus, a sensor network can be described as a collection of sensor nodes which co-ordinate to perform some specific action.

2.2 Need of the Proposed System

There are variety of irrigation systems exists which farmers are using for agriculture and gardening & one of the system is automatic sprinkler systems can save water if and only if they are well installed and maintained but still we cannot say utilization of water will be less. Normally people opt for automatic sprinkler systems to avoid being bothered with the irrigating to the lawns, but people just have habit to "set them in the field and after some time forget them". Ultimately it increases the wastage of water which is not acceptable. Definitely this method of automatic watering accomplishes the task of keeping the lawn green and beautiful, but still it uses significantly more water than the grass requires. Once installed in the fields we can observe that many people uses automatic sprinkler systems have broken pipes and because of this wastage of water cannot be controlled, broken sprinkler heads may be one of the reason and human being we are tolerating these things. Sprinkler heads are also not correctly aligned as alignment is important. These problems contribute to unnecessary water wastage and especially they are unnoticed when the lawn is being watered at night while people sleep. Nowadays there is need to encourage people to be better water managers to save it, as it is a natural resource and we are observing irregular nature of monsoon. But to spread a message and make people aware about the water utilization, it is a difficult and challenging task. But as time has been passed and due to advancements in technology all irrigation controllers are programmed which is very good. In this paper authors also stated that, there needs to be a better way for controlling sprinkler systems to conserve water and every one must go for it.

For example forty minutes a day could be programmed to be ten start intervals for four minutes each. In this way if the sensors sensed that the soil was dry enough for irrigation to occur, then it would allow five minutes of watering to happen at this specific plant. After this next cycle will begin, it "sensed" that it received moisture from the first cycle, it would preempt the next three cycles from occurring i.e. technically known as preemption.

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For such preemption to occur in a systematic manner Scheduling is required. E.g. priority driven scheduling can be programmed in a way that high priority task will preempts low priority tasks. With this scheduling technique the irrigation will takes place. [54]

2.3 Root Zone Moisture Extraction

Good and important points noted in this article are as follows:

- The best time for irrigation is the morning time when wind flow is low, water pressure is highest, demand from the plants is low, and evaporation rate ET is also low as temperature is low.
- Irrigating in the evening will places water drops on the leaves for long time, which enhances various disease to the plants.
- If possible, during irrigation care has to be taken about the water level in the soil. We can also go for additional cycle of the irrigation system to avoid the losses w.r.t. less irrigation also one should take care that excess amount of water cannot be given to plants else it will affect the production yield

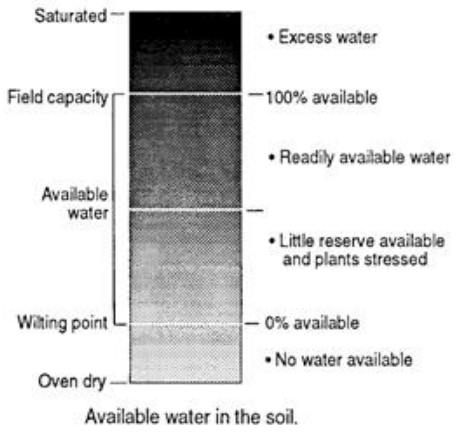

Figure 3 Root Zone Moisture Extraction

2.4 Wastage of Natural Resources

In the following picture from this article it is easily observable that as we are talking about the water utilization, in all the formats / types water utilization is not taken seriously.

In the proper irrigation system management, focus should be on conserving the water at any cost. As we are observing day to day ground water level is decreasing and drinking as well as for irrigation water required is not sufficient. In such a situation it is important to consider water as import natural resource and everyone must try to utilize it in the optimum way.

Figure 4 Existing Irrigation Systems

III. Implementation Details

3.1 Use of WSN

This paper is a research work based on WSN virtualization framework, related work, current status and future work. WSN virtualization, which we can say achieving maximum throughput by utilizing the same infrastructure and it is relatively new field. We can say WSN virtualization can handle many tasks with underlying same resources but concurrent execution is not easier. Overlays can be used to have multiple applications access the WSN platform / resources but they require careful analysis. In this paper an overview of WSN virtualization framework and its related issues are presented. WSN virtualization is developing field of research where we can possibly explore the power of sensors. With the help of WSN devices anyone can initiate the research work and therefore new applications are invented.

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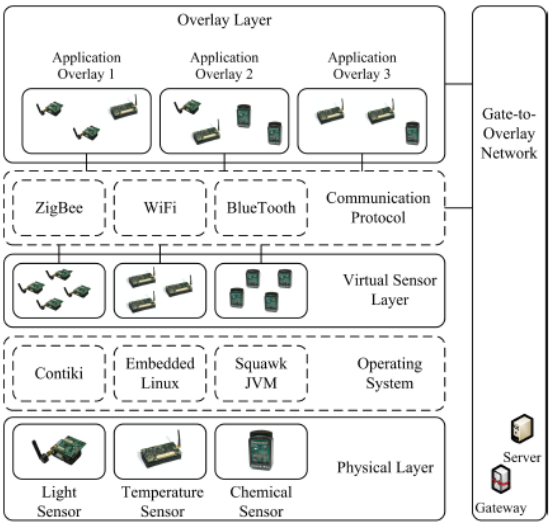

Figure 5 Framework of WSN

3.2 Best Water Utilization

It is assumed that any water can be given to the irrigation but it is not correct and good. As water will have its TDS, pH, Salinity etc. by which we can decide whether water is good for the production yield of the crops. Because it directly impacts on the growth of the plant / crops. Therefore in the above mentioned diagram we have shown pH, Salinity and TDS of the water can be checked at first and then if the retrieved values are permissible then only water will be irrigated to the plants. That is the ultimate one of the goal of the proposed system, we are expecting that system will immediately display message on the desktop application to the user if the values are acceptable. In our proposed system this will be the advantage that we are checking these parameters of the water and then utilizing the water. Up till now, existing systems are just focusing on the irrigation but we are focusing on the optimal utilization of best water for the crops. Ultimately these will impacts on the crop growth and production yield. As we are focusing on the calculation of the weekly, monthly, bi-monthly utilization of the water, these sensed and calculated values must be stored somewhere. In database we will store those values and at any time for analysis purpose we can fetch from the database.

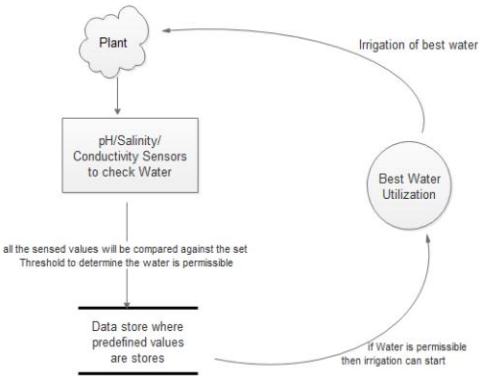

Figure 6 Best Water Utilization

3.3 Storing and Retrieving Values

As we are developing a application through which we are indirectly communicating with the nodes involved in the proposed system. In the above diagram we are observing that 'n' values will be retrieved and those will be stored in database e.g. we are using MySQL. Therefore MySQL query calls will be executed during storing and retrieving the values to and from database.

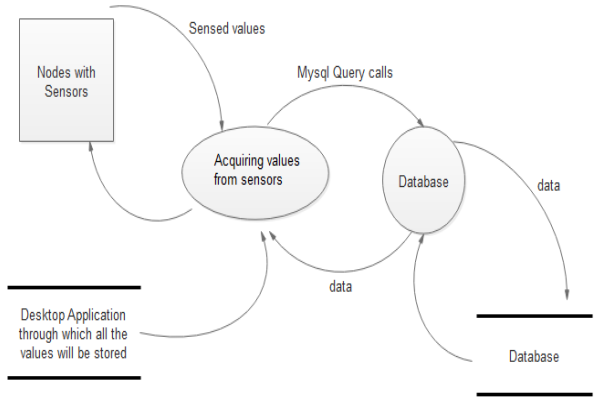

Figure 7 Storing and Retrieving Values

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3.4 X-Bee

Node connected to moisture sensor that gives off its reading in volts and Data transmits to Coordinator (receiver) node. X-CTU is a free software tool available from Digi International to interface with X-bee modules. The tool provides a GUI and terminal interface to configure the modules as well as a built in tool to test the X-bee range and reliability of packet transmissions.

Figure 8 X-Bee Device Series 2

3.4.1 X-bee data transmission

X-Bee data packets can be transmit as either unicast or broadcast transmissions. Unicast transmissions route data from one source device to one destination device, whereas broadcast transmissions are sent to many or all devices in the network.

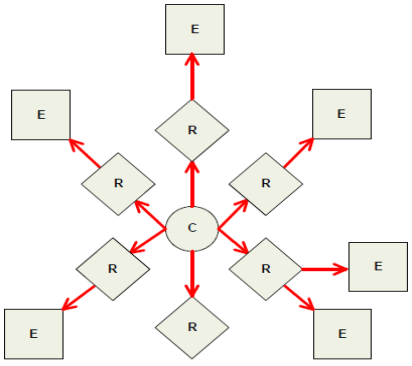

Figure 9 X-Bee Data Transmission

3.5 Moisture Sensing Subsystem

Following diagram is moisture sensing sub system which shows Water Supply module, Control Station, Nodes with Sensors. Water supply at this module we are checking first whether water is good for the crops or not. Then with the help of solenoid valve only that crop will be immediately irrigated where moisture level is very low.

Control Station will fetch the moisture readings from sensor nodes and will invoke priority driven method which will irrigate the crop where moisture is very low.

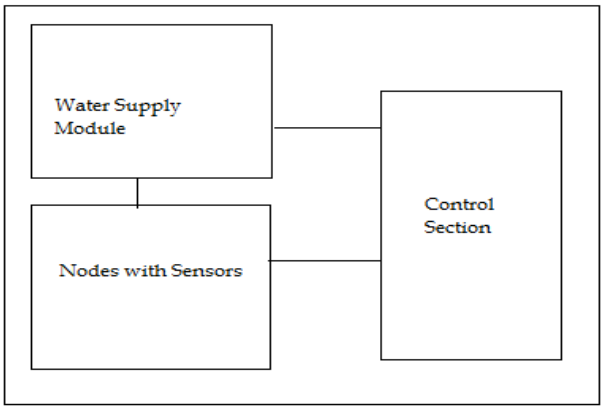

Figure 10 Moisture Sensing Subsystem

IV. Soil Sample Testing & Results

4.1 Based on pH

Soil samples have given to Agriculture University so that at initial we can conclude which soil sample is good as compare to other soil sample. Then we will correlate these values after applying our Priority Driven Strategy approach. Our intention is to show how priority driven approach will save the unnecessary wastage of the water and how the moisture of soil will be maintained. We will show the importance of priority driven approach in recent days where monsoon is irregular and maintaining ground water level is very important. Initial comparative results before using soil samples for the proposed system are as follows:

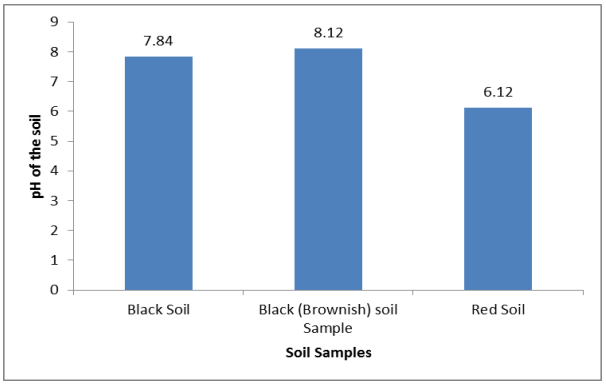

Figure 11 Soil Comparison based on pH

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4.2 Based on EC

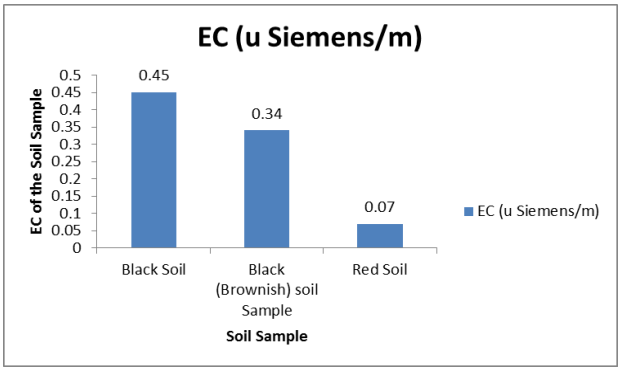

Figure 12 Soil Comparison based on EC

4.3 Based on Moisture

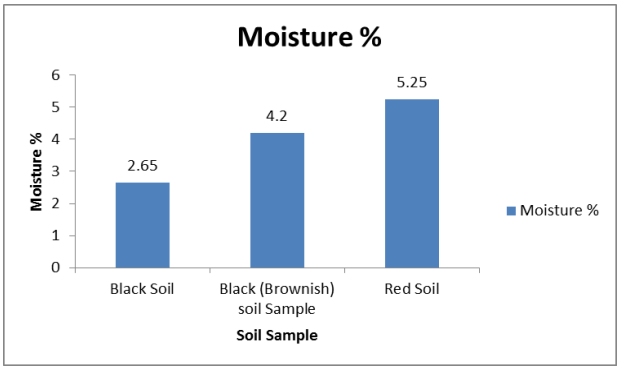

Figure 13 Soil Comparison based on moisture

V. CONCLUSION

People says these type of systems are future needs but according to us intention behind developing such systems are the current needs as climate is changing rapidly and every citizen is responsible for preserving our nature and natural resource too. In our day to day life few good things we must adopt to reduce and managing the risks else next generations won't be survived. Utilization of natural resources is the important challenge and everyone should contribute to climate-resilient pathways for sustainable development. It is nothing but utilizing the natural resources in an effective way. With this regard we have proposed a system which is based on priority driven approach which proves that in wireless sensor network environment can be a better option for better crop yielding. With this WSN approach few of the nodes will acts as a sensor nodes (slaves) and two or three will acts as master nodes (processing center).

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