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Agricultural Environmental Sensing Application Using Wireless Sensor Network for Automated Drip Irrigation

Manish B. Giri[1], Ravi Singh Pippal[2*]

[1]*Research Scholar,* [2]*Professor*
Department of Computer Science & Engineering, RKDF University, Bhopal, India

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***Abstract*—**The advent of Wireless Sensor Networks (WSN) has given a new directions to agriculture research and farm trading. Currently every day WSN has wide use in agriculture sector. In this paper, we have tendency to review the potential WSN application that specifies the problems and necessary requirements for drip irrigation for the optimum utilization of the available water. We have tendency to gift works that is associated to use WSN in agriculture correctness and production management. In this regard, various methods of WSN deployment and implantations are surveyed. So we tried to highlight the challenges and problems of these solutions, while identifying the factor for improving the intelligent drip irrigation system.

***Keywords*—**Drip Irrigation System, Precision Farming,Wireless Sensor Network

I. INTRODUCTION

In India, where the economy is mainly based on agriculture, the climatic conditions are unit isotropic and are not ready to fill agricultural resources. The main cause of un-irrigation land is less rain fall .Another known reason for this is due to uncontrolled wastage of water. In the recent irrigation systems, the most advantageous part is that water is supplied near the root of the plants. Hence large quantity of water is saved, at the present days; the farmers are using irrigation conventional technique to control the farm production [1]. Due to manual process, sometimes more than required water gets supplied or sometimes less than required. This leads improper growth of plants. This problem can be perfectly rectified if farmers will be able to use automatic irrigation system by using Wireless Application [2]

This process sometimes consumes more water or sometimes the water reaches late due to which the crops get desiccated. Water defalcation can be detrimental to plants before visible wilting occurs

Slower excrescence rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly emended if farmers adapt automatic irrigation system by using Wireless Application [2]

Corresponding Author: *Ravi Singh Pippal,*
ravesingh@gmail.com
Department of Computer Science & Engg., RKDF University, India

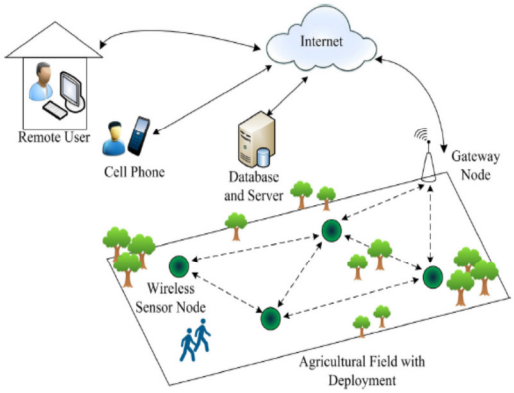

Figure 1 : A typical WSN deployment for Agriculture Application [8]

This paper focuses on the optimum utilization of available water by distributing among multiple crops as per their requirements. Capitalization of Wireless sensor network to get the accurate measurements of soil moisture parameters for distribution of the available water to the crops are surveyed through various papers.

The rest of the paper is organized as follows. Section II deals with conventional irrigation. A brief introduction to drip irrigation is shown in section III. Noteworthy contribution in this field is discussed in section IV and finally, section V concludes the paper.

II. CONVENTIONAL IRRIGATION

Irrigation is the process in which water is supplied to plants at different intervals in agriculture. It is used in abetment of growing of agricultural crops, maintenance of farm field,

and rebuild of disturbed soils in dry areas and during periods of insufficient rainfall. Irrigation also has a few other uses in crop production, which include protecting plants against rime [3], suppressing squatter growth in grain fields [4] and preventing soil amalgation [5]. In contrast, farming or the crop cultivation that relies only on direct rainfall is referred to as rain-fed or dry land farming.

Figure 2 : Conventional Irrigation

In surface irrigation systems, water floods across the surface of farm field, in order to wet it and percolate into the soil. Surface irrigation can be categorized into furrow, *border strip or basin irrigation*. When in the irrigation, aftereffects are flooding or near flooding of the cultivated land then it is called as *flood irrigation*. This has been one of the most common methods of irrigating land and still used in most of the parts of India. They are some cases, where water is pumped by motor, or put up by human or animal power to the level of the land. In this case, water efficiency of surface irrigation is comparatively at lower side than other forms of irrigation, but has potential for better efficiency under proper monitoring.

Pivot Irrigation

Center pivot irrigation is a method of sprinkler irrigation where of several small parts of pipe joined together and backed by trusses, horsed on wheeled towers with sprinklers located along its length [6]. The system circulates the water in all directions from the pivot point in the middle of the arc. These systems are common in almost all parts of the terrene. New methods have drop sprinkler heads instead. It is very common that center pivot systems has drops hanging from a u-shaped pipe at the top of the pipe with sprinkler top that are deployed at upper side the crop, so that can shades evaporative losses. Drops can also be used with drag hoses or bubblers that spray water directly in the farm field between crops. Crops are usually planted in a circle to tune to the center pivot. This is called as Low Energy Precision Application.

III. DRIP IRRIGATION

Drip irrigation, also referred as trickle irrigation. In this system water is distributed drop by drop just at the roots of crops. This method can distribute water in most efficient way [7], if properly managed. In this method water vaporization and overflow are reduced. The farm field water efficiency of drip irrigation is basically in the range of 80 to 90 percent when persuaded correctly.

Now days, drip irrigation is used with plastic mulch to reduce further evaporation, and can also be used in distribution of fertilizer. Deep penetration, where water flows below the root zone, can appear if a drip system is operated for longer duration or if water distribution rate is much high. In Drip irrigation methods, lower water pressure is maintained than most other types of irrigation systems, with consideration of low energy center pivot systems and surface irrigation systems. This system can be designed for oneness of the field or for restricted water distribution to individual plants. Even it is quite difficult to control the water pressure on steep slopes, pressure reducing components are available.

IV. LITERATURE REVIEW

Recently many researchers have tried to introduce alternative and very useful methods in agriculture sector. The methods are introduced for various challenges, we need to undergo for implementation of WSN such as sensor node and its durability, transmission methodology, power used for data transmission, energy efficiency utilized in real-time implementation, Data storage and its availability as well as its retrieval procedure. Till now so many researchers had worked on these issues and many more are still working as it is a new emerging and widely used technology. Ojha et al. [8] highlighted the various applications of WSN, and their potential to solve various farming issues. He presented network and node architecture of WSN, the factors associated with it, and classifications according to different application. He concluded with remarks on WSN based solutions for drip irrigation management, crop disease predictions, vineyard precision farming.

Llerena [9] focused on short term and long term effects for irrigation and tillage system on soil properties. His study shows that, in short term, sprinkle irrigation gives a lower yields, in the midterm, with combination of irrigation methods with no tillage yields same as conventional irrigation system. He concludes that in long term, water savings and soil improvements are sustainable. The following figure (Figure 3) gives the details of irrigation architecture.

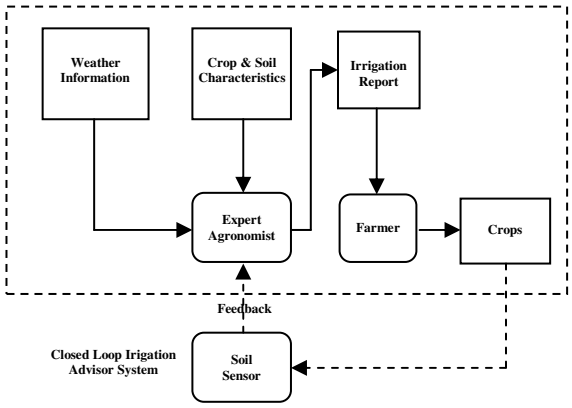

Figure 3 : Architecture for Sensor Network Irrigation System

Hellin [10] has proposed two machine learning techniques PLSR and ANFIS for analysis and performance based on accumulative effects due to errors in consecutive weekly estimation. He worked on use of real time information from soil parameters in a closed loop control for adapting decision support system to local perturbations, avoiding accumulating effects. Polo [11] proposed a low cost WSN for agriculture environment monitoring server system. To cover long distance, he used unmanned Arial Vehicle (UMV) to collect the information stored in the nodes by a mobile node or mule. A mobile sensor node or mule is designed to collect the data from static sensor nodes. The vehicle has image sensor which sends videos which provide information of ground nodes as well as pets movement or like problems that affects plants growth. The UMV contains several subsystems that enable different functions to be operated.

Sun [12] presented a Real Rain, a real time interrupt driven WSN application for large scale rainfall monitoring system. The author has considered two important concepts of time synchronization and data reliability to design effective and resource efficient approach. This provides a facility of effective deployment of Real Rain in different conditions. The RealRain system provides a powerful observation which helps end user to make fine grained models or accurate online data analysis of rain fall in a specific area or region. This system provides a time match precisely and data reliability for environment sensing applications.

Kim [13] has proposed new sensor network architecture with autonomous robots based on beacon mode for real time agriculture monitoring system. The scheme also enwraps a reliable alliance with parent nodes and dynamically assigns network addresses. For the great scope multi-sensor processing, this system accomplishes the database, which spreads alert messages to the handheld terminal by means of the re and air-based sensor data. Thus farmers can check out the current conditions of crops at ease and farms at anytime and anywhere. Moreover, the author also developed a mobile device platform for mobile surveillance.

Zhen Li [14] addresses the issue of two tier wireless sensor network system for unsupervised, real-time, in field soil property data acquisition. Within the system, a local wireless sensor network was formed to capture real-time soil property data including moisture content, electrical conductivity, and temperature at different locations and at different depth levels of field. A long range cellular network and Internet services were used to propagate the field data to a remote side database on a web-server for data storage and user analysis.

Aqeel-ur-Rehman [15] has reviewed several solutions and efforts have been presented in this paper towards agriculture sector. The major concerns are:

a. Resolutions are complex to implement and requires major technical support
b. Increased Cost is involved
c. Lack of nonspecific solution to different services and problems

B. Majonea [16] has proposed a novel methodology for deployment and testing of a WSN monitoring system capable to provide geographically apart hydrological data relevant for Eco-hydrological studies. Monitor soil moisture dynamics to analyze interplay between soil moisture dynamics and plant physiology. Xin Dong [17] the author developed a neoteric system through the synthesis of center pivot systems with wire-less underground sensor networks, i.e., WUSA-CP, for sovereign precision agriculture (PA). The system gathers soil information, such as soil moisture, from a WUSN in real time to electronically control the CP for precision irrigation.

Xiaoqing Yu [18] analyzes a hybrid wireless sensor network architectonics for agriculture. This network reduces the intensive human entanglement required in current agricultural information anthology and provides information that is more specific than the existing sensor networks. This foremost sensor network includes a terrestrial wireless sensor network and a wireless sub terrestrial sensor network. The hybrid WSN architecture incorporates the advantages of existing sensor techniques. Coates [19] designed actuator hardware and rmware for congruity with a commercial wireless network node. Wireless network extensity varies with radio height and type of hindrance, reaching 1610 m under visible horizon conditions and 175 m under stonewall circumstances. Nodes were updated with custom rmware that conceded commands received by the node to be transmitted to hooked up actuator. The actuator

received commands through the node, rejoined with actuator data, and operated up to 4 latching valves.

Yingli Zhua [20] has developed a design of agricultural environment monitoring system based on wireless sensor networks; the system works on low power consumption and has stable running and higher precision, which can realize remote real-time monitoring for abandoned agriculture environment monitoring. Wire-less sensor networks applied in monitoring agriculture habitat breaks through the wide accepted methods and ideas for agricultural environment monitoring, which advances the level and reliability of monitoring system. Zhao Liqiang [21] proposed an agricultural application of wireless sensor network. The main work is to develop two types of nodes and to deploy sensor network. The hardware platform is fudge together by data process unit, radio module, sensor control matrix, data storage, electric power supply unit, analog interfaces and extended digital interfaces. The software system ratifies Tiny OS which is composed of system kernel, device drivers and applications. Energy-retaining algorithm is implemented in the software system.

Soledad Escolar [22] presented a methodology that can successfully guide the Process of building monitoring applications for farm field provision based on WSN technology. The methodology covers the complete life cycle of applications, from raw seeds requirements to entire production phase. The catalyst for describing a approach is to collect a set of best-practices and gimmick that are found in the literature. This can bridge the gap between how applications are used and a booming, tailor make approach.
Although current irrigation system has automatic water timer and the system will turn on irrigation system at the right time. It does not accurate in plant growth as it does not monitor the main factors for watering plants which are temperature, air humidity and soil humidity. Further the same can be elaborated for checking the soil humidity along with the factors which are present in water whose presence have direct impact on growth of crops such as water purity, chemical components of water as well as different ions or nutrition present in water.

V. CONCLUSION

The use of WSN is a powerful tool or a technique in agriculture sector in improving farm yield. In this survey, we present a common platform where WSN can be applicable on various aspects of agriculture sector. We reviewed the different ways deployment of sensor network for production monitoring purpose or WSN potential to solve different problems in agriculture sector. As various authors proposed different methods for different problems, automatic drip irrigation system has a scope to improve distribution of water among multiple crop cultivation system.

This survey of existing works leads us to conclude with few remarks; we need to find out some common method to predict the accurate water distribution system which can lead to use optimum available water. Different climatic parameters have to be considered to predict the current requirements of crops. At the same time, we can say that, using modern technologies, there remain a scope for cutting edge and competent systems. In future, the interpolation can be one of the suitable methods to determine or predict the required soil moisture values for water distribution, or interpolations methods can be applied on various data collection to predict, current water requirement of a specific crop in current climatic conditions.

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AUTHORS PROFILE

Manish Giri is pursuing Ph.D. (Computer Science and Engineering) from RKDF University, Bhopal, India. He has completed MTech from SRTM University,Nanded in 2008. He is author of many papers. His primary research areas of interest include Computer networking, WSNs and Software Engineering.

Dr. Ravi Singh Pippal is presently working as a Professor (Computer Science) in RKDF University, Bhopal, India. He has obtained Ph.D. fromABV-Indian Institute of Information Technology and Management,Gwalior. His primary research areas of interest include Cryptology (Cryptography, Cryptanalysis), Steganography, Key Management,Image Encryption and many more.

