IJCSC 0973-7391 Volume 7 • Number 2 March 2016 - Sept 2016 pp. 108-114 available online at www.csjournalss.com

Review of Solicitation of Wireless Sensor Networks in Precision Agriculture

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Abstract: Because of the capabilities, the sensor nodes are being adopted in most of the real world scenarios. In agricultural field, the sensor nodes if deployed with efficient data aggregation scheme and energy monitoring mechanism can be proved very beneficial. The motto of this work is to make the survey of application of Wireless Sensor Networks in the domain of Precision Agriculture. A number of specification parameters in different works proposed by researchers are discussed.
Keywords: Precision Agriculture, Wireless Sensor Network, Decision Support System, Internet Messaging Practice.

I. INTRODUCTION

Human beings need water and food for survival. The farmers have to face many problems due to various phenomena occurring in the vicinity of the field areas like flood, draught etc. The conventional methods of irrigation, fertilization are not sufficient to produce better outputs. The efficient use of the agricultural resources such as land, water is essential for good yield. The crops should be planted with proficient security and protection mechanism. There should be weather prediction mechanism and the capability to bear unfavorable issues encountered.
In India, Agriculture is the most considerable profession. A very large number of persons earn by agriculture and the related fields. So the production of all the crops should be moderate enough because the imbalance may cause huge loss in the overall revenue of the country. If the farmers anyhow can know about what type and what amount of soil, water, fertilizer etc. are actually needed at what location; then we can say that the farmers can be secure in the sense that any unfavorable issue cannot harm them significantly. This is the modernization in agricultural domain.
Precision Agriculture (PA) is the monitoring and controlling of the relevant environmental parameters of the crops. This includes the concept of Greenhouse in which the crop being planted is observed by maintaining and regulating the environmental parameters to desired level by using decision making capability. PA proves to be efficient in the sense that it monitors the crop by telling exactly what amount of soil, water and fertilizers are needed at what points of deployment.
Wireless Sensor Network (WSN) is growing at a fast speed in the real world fields. It will be feasible to provide all relevant information of the monitored environmental parameters to the farmers by using various messaging applications through Internet Message Practice (IMP).

A WSN is composed of a number of nodes which have following features:

- Ad hoc Approach
- Limited Power
- Limited Energy
- Small Size
- Limited Memory Capacity
- Mobility of Nodes
- Dynamic Topology
- Huge in Number
- Easy and simple to implement

Issues in Wireless Sensor Networks

- ***Energy Depletion***

The sensor nodes need to detect the events, to process the relevant information and transmit it to the base station. If we are using the network of multi-hop communication then energy is also exhausted in routing the data over transmission links. All these activities need a considerable amount of energy and power. However the sensor nodes usually have finite and limited energy level. The lifetime of the whole network depends on the life of each and every sensor node in its region because battery is the only means used for this purpose, usually non-chargeable.

- ***Information Attainment, Sampling and Transmission***

For obtaining the relevant information, data sampling and transmitting the essential characteristics from the target node to sink node in multi-hop communication, energy level reduces to some extent.

- ***Fault Tolerance***

The sensor nodes could be damaged due to the external environmental conditions, flood, and drought etc. The sensor network may get blocked due to attenuation, and distortion etc.

- ***Size***

The sensor nodes should be small in size for large scale and effective deployment. The field should be provided with appropriate protection mechanism for avoiding the risks of heavy rain and heavy wind situations.

- ***Location*** This is very important to consider the location of the sensor nodes to be placed to cover the supreme measurements of the readings of various environmental parameters. So the infrastructure is to be designed carefully and implemented accordingly.

Why there is need of sensors in Precision agriculture?

The sensor nodes are employed for receiving the data about the environmental factors related to the fields in which the deployment is to be performed.

The domain of Precision Agriculture postures numerous necessities:

- Gathering of climate and harvest data
- Nursing the dispersed coverage area
- Manifold harvests in field
- Diverse requirements of soil, water and fertilizers
- Varied necessities of harvests aimed at dissimilar climate and harvest data
- Hands-on elucidations preferred over reactive explanations

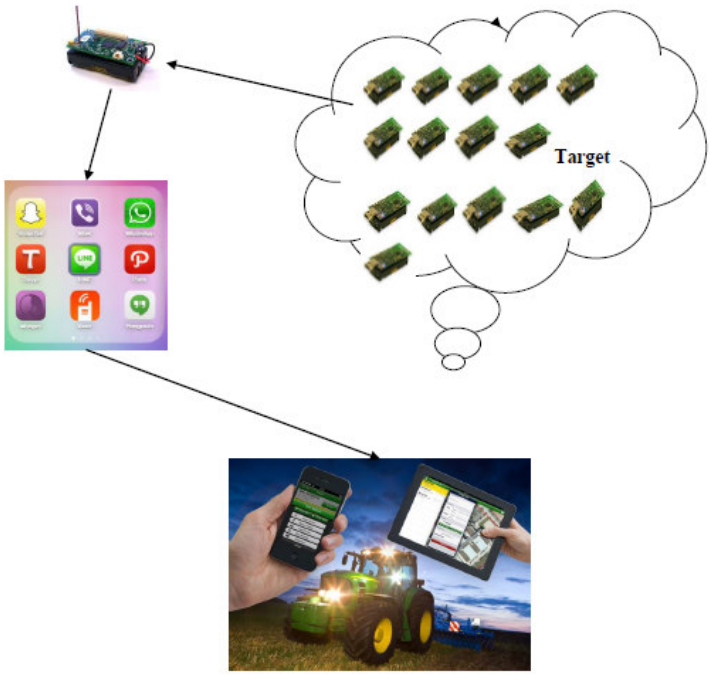

Figure1. Precision Agriculture using Wireless Sensor Network

The requirements mentioned above are needed for distributed as well as parallel applications. Also the sensors and actuators are required for receiving the relevant information and for working on issues raised. So a Decision Support System (DSS) is strongly recommended. Figure 1 shows the implementation of Wireless Sensor Network with Internet Messaging Practice in Precision Agriculture.

II. LITERATURE REVIEW

This review paper discusses the implementation of various works done by the researchers based on a number of environmental parameters. The following table compares the research works in agriculture field for numerous difficulties allied to rural assets optimization, resolution constructing provision, and land monitoring.

M. R. M. Kassim et al. [1] stressed the application of sensor technology in agricultural domain for solving the issues related to asset optimization, decision drawing and monitoring the land area. B. B. Bhanu et al. [2] emphasized the monitoring and controlling of the agricultural field using sensor technology to enhance the yield and quality of crop.

I. Mampentzidou et al. [3] stressed upon the fundamental instructions for sensor technology in agricultural domain. It discusses the essential components to be considered. T. Kalaivani et al. [4] surveyed Zigbee Based Wireless Sensor Networks for agricultural parameters monitoring.

S. Li et al. [5] stressed upon sensor technology for controlling agricultural work using Precise Agriculture Monitoring. Precision Agriculture Monitor System (PAMS) that observes and controls the crop. Y. Jiber et al. [6] described the outline for agricultural observation using iFarm framework system, to improve the production, to manage the watering activity and to enhance the socio-economic factors.

S. R. Nandurkar et al. [7] opined on the design and development of agricultural system using sensor technology to observe various ecological parameters. H. Sahota et al. [8] explained the sensor technology for agricultural area by working on MAC and Network layers.

A. U. Rehman et al. [9] reviewed the importance of sensor technology in agricultural domain. M. Mafuta et al. [10] emphasized on the application of sensor infrastructure for monitoring and maintenance of crops in an Orchard.

N. Wang et al. [11] presented the outline on latest designing of sensor technology for ecological nursing. N. Rajput et al. [12] described in brief the survey of sensor technology in apple farming in India. M. H. Anisi et al. [13] classified the sensor technology and performance metrics.

Table 1. Summary of Components used in Research Works [Reference Sr. No.]

COMPONENT	1	2	3	4
Monitoring System	Vineyard	Orchard	Agriculture & Food Industry	Apple Farming
Area Size		700 Acres on hilly area		
Measured Factor	Humidity, Air temperature, Wind speed, Wind direction			Air Temperature, Humidity, Soil moisture
Topology/ Architecture	Star/Single Hop Topology		Star/Hybrid/Mesh	
Node Platform	Crossbow barkeley-Mica2,MicaZ & shockfich etc.	MICA2		
Microcontroller	MSP430 & ATmega microcontroller			
Sensors	Sensirion SHT75 or SHT71		MEMS sensors	Capacitance type moisture sensor
Protocols/Algorithm	Delta Compression Algorithm			
Node O/S	Tiny O/S	Tiny O/S		
Power Supply	Lithium, NiMH & Alkaline			
Technology		Zigbee Technology	Zigbee Technology	

COMPONENT	5	6	7	8
Monitoring System	Green House	Zigbee based WSN	Mkrishi Framework	Real Time Health Monitoring
Area Size		30m to 75m	Range 400m (for 6 months)	10m to 100 m
Measured Factor		Weather temperature, Wind speed, Wind direction	Soil moisture, Temperature, Ambient temperature, Humidity	
Topology/ Architecture	Star Topology		Mesh Topology	
Node Platform		MICA2	MICA/Telos	MICA2/MICAZ
Microcontroller				Neck mounted animals sensory color to track
Radio Transceiver	Wireless Transceiver module		CC2530 Texas Instrument	
Protocols/ Algorithm			TCP/IP,UDP,HTTP,FTP	
Node O/S	Tiny O/S	Tiny O/S	Tiny O/S	
Communication N/w	N/w communication with gateway/ one way communication			
Power Supply	6V Lithium-Carbon Batteries	Solar Cell or AA Batteries	Lithium-ion Batteries	
Waterproof Case			Rain fed farming	
Technology	Zigbee Technology			

COMPONENT	9	10	11	12
Monitoring System	Farmland & Green House	Health Monitoring	Green House Monitoring	Irrigation Management System
Area Size				75m to 120 m
Measured Factor	Temperature, Humidity, Illumination, CO_2 level	Temperature, Moisture	Temperature, Light, Wind speed, Wind direction & Water level	Soil moisture, Temperature, Battery voltage level
Topology/ Architecture			Star/Multihop	Star/Cluster Tree/Mesh
Node Platform		MICA2		
Microcontroller	Atmega 8-bit high performance microcontroller	MDA300CA	IEEE802.5.4	IEEE802.15.4/ wapsmote microcontroller
Radio Transceiver	AT86RF230			Xbee transceiver
Protocols/ Algorithm	CTP Protocol/ EDABA (Energy Balanced Data Aggregation Algorithm)		Ambient light sensor, temp & humidity sensor	Soil moisture sensor (TP1000)
Node O/S	Tiny O/S 2.1	Tiny O/S 2.1.1	Tiny O/S	
Communication N/w	TCP/IP		RS-232 from sink to data over TCP	
Power Supply			Lithium-ion Rechargeable	Lithium-ion Battery L182D01-2B10A
Waterproof Case				Watermark 200SS sensor
Technology				Zigbee Technology
Processor Used			Pentium-M1.6 Ghz	

III. FUTURE RESEARCH WORK INSTRUCTIONS

- Efficient energy management mechanism is required to provide longer network lifetime to the system.

- Rechargeable batteries and Renewable energy sources are preferable.

- Compatible hardware compatible platform is needed.

- Efficient software infrastructure is desired.

- Effective data aggregation technique is needed.

- Reliability is demanded by adopting fault detection and fault management mechanism.

IV. CONCLUSION

The fundamental parameters of the agricultural domain are discussed. The table based on the mandatory components for Precision Agriculture using Wireless Sensor Networks is reviewed. Yet an efficient technique comprising a reliable energy controlling and data aggregation concepts is strongly recommended which will be proved very beneficial in terms of cost and revenue.

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