Reviews on Agro-Sense: Precision Agriculture Using Wireless Sensor Networks

Ms. Neha A. Wadaskar, Prof. S. A. Ladhake

Abstract Precision Farming is that the conjunction of a replacement management perspective with the new and rising data and communications technologies resulting in higher yields and lower prices within the running of enormous scale industrial agricultural fields. It guarantees higher yields and lower input prices by time period and automatic observation of web site specific environmental and soil conditions victimisation completely different sensors and thereby up crop management, reducing waste and labour prices. Wireless sensing element networking is gaining quality for managing exactitude agriculture through time period observation of agricultural parameters and weather conditions. Cheap simulation tools exist for evaluating giant scale sensing element networks; however, they fail to capture sensible aspects of wireless communication. Reality test-beds bring out actual challenges and vital aspects associated with large-scale readying of sensing element networks. During this paper, we have a tendency to gift a test bed implementation of a wireless sensing element network for automatic and time period observation of soil and environmental parameters influencing crop yield. The paper describes the system design, physical setup, sensing element node hardware and software package for time period observation and management of agri-parameters through a straightforward graphical interface. The paper presents sensible problems and technical challenges together with the mixing of sensors, placement of sensors in out of doors setting, energy management theme and actual power consumption rates.

Keywords— *IEEE 802.15.4, Wireless Mesh Networks, Routing Algorithm, Precision Agriculture*

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I.INTRODUCTION

Agriculture provides the economic underpinnings for the bulk of rural Republic of India. In past few years, new trends have emerged to enhance the various areas of agricultural sectors mistreatment the fashionable technologies. Climatological condition watching is one in every of the foremost necessary aspects in agricultural production that has its direct impact on the productivity a maintenance of field crop. a large loss is incurred per annum thanks to damages of crop by varied diseases caused by improper maintenance of some climatological conditions.

Moreover, observance totally different climatological, soil parameters like temperature, humidity, soil wetness, soil pH, soil physical phenomenon, leaf status, sunshine etc. in real time is very important for higher management and maintenance of agricultural production. If these factors are often maintained properly, that, in turn, might forestall the severe attacks of diseases on the crops. This can additionally facilitate the farmers to require correct and timely actions relating to irrigation and fertigation etc. to forestall any quite damages within the crop, supported the circumstances in every individual field. This drawback provides birth to a brand new domain referred to as preciseness Agriculture [1, 2, 3]. Precision farming depends upon intensive sensing of environmental conditions and laptop process of the ensuing information to tell decision-making and management farm machinery. A wireless sensing element network is a perfect candidate for observance such environmental conditions poignant agricultural practices.

II. FEW INITIATIVES USING WIRELESS SENSOR NETWORKS FOR PRECISION AGRICULTURE

A. "Smart Fields" with Wireless Nano-sensors

Since several of the conditions that a farmer might want to monitor (e.g., the presence of plant viruses or the amount of soil nutrients) operate at the nano-scale, and since surfaces can be altered at the nano-scale to bind by selection with explicit biological proteins, sensors with nano-scale sensitivity are going to be significantly vital in realizing the vision of sensible fields. The United States Department of Agriculture (USDA) is functioning to push and develop a complete "Smart Field System" that mechanically detects, locates, reports and applies water, fertilizers and pesticides - going on the far side sensing to automatic application. [4]

B "Smart Dust" Sensors/ motes

Ten years agone, dagger Pister, a proof of AI at University of CA Berkeley initiated the event of autonomous sensors that may every be the dimensions of a match head. exploitation semiconductor etching technology, these motes ("smart dust" sensors) would feature associate degree aboard power provide, computation skills and also the ability to find and so communicate with alternative motes within the section. During this manner the individual motes would self-organize into impromptu networks capable of relaying information exploitation wireless (i.e., radio) technology.

Currently, motes square measure on the market from bow Technologies [9], Dust, Inc., coal and period of time internet.

Motorola, Intel and Philips are functioning on the event of motes and trade has already started experimenting with wireless detector networks exploitation motes for agriculture.

Computer chip maker Intel, whose chips have nano scale

Features, has put in larger wireless detector nodes (called 'motes') throughout a farm in Oregon, USA wherever the sensors live temperature once in each minute. Intel's vision for wireless networks is 'proactive computing' - omnipresent systems that anticipate the requirements of the farmer and act before they're asked to try and do thus.

In a similar venture, international firm Accenture has partnered with mote-maker period of time internet to run a network of sensors across a farm in CA.

According to bow Technologies, their motes are often used on the farm for irrigation management, frost detection and warning, chemical application, harvest temporal order, bioremediation and containment, and water quality measure and control[4]

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C. SoilNet - A Zigbee based soil moisture sensor network

Soil wetness plays a key role in partitioning water and energy fluxes, in providing wetness to the atmosphere for precipitation, and dominant the pattern of groundwater recharge.

SoilNet project aims to develop a soil wetness sensing element network for observation soil water content changes at high spatial and temporal scale.

Main options of SoilNet are:

- ZigBee primarily based Wireless sensing element Network with mesh topology,
- terribly low energy consumption for long battery life
- Dynamic, expandable network,
- Different node configurations for custom-made mensuration setups,
- Measured information hold on during a information (easy and variable access)

The small drainage area of the Wüstebach (about twenty six.7 ha) was planned to be instrumented with the planned soil wetness network, Soil Net. The sensing element network consists of 286 sub nodes and twelve arranger nodes. the complete network was managed by a main server that may even be connected with telecommunication (e.g. DSL) so as to alter on-line transmission to the geographic point.[5]

III. Proposed System Description

A. The system requirement

A exactness farming system ought to embody following basic functionalities:

- Sensing agricultural parameters in period of time particularly, soil parameters, setting parameters etc
- .Identification of sensing location and information aggregation.
- Transferring the aggregative information from crop field to regulate station for higher deciding.

For this application, sensors ought to be placed outside, within the open field, wherever power might not be offered.

So, sensors ought to be battery operated. Sensing location is also known by desegregation GPS with every detector. However, that's not a price effective resolution. during this application, sensors area unit statically placed at totally different locations in a very field, that the static location of every detector with its distinctive detector id are often keep within the sensors throughout network configuration and preparation part.

In exactness agriculture, continuous watching of detector information at each minute might not be perpetually required.

Instead, the information is also monitored on hourly basis or at totally different times of the day, e.g., morning, noon, afternoon and evening. This, in turn, helps in protective the battery power of detector nodes. It's additionally higher to use "sleep and awake" cycle of the wireless detectors judiciously to sense and transmit the sensor information in wake-up phases and place the sensors in sleep mode remainder of the time. it's going to be sensible plan to mixture the detector information captured over a amount of your time at every node before causing the aggregative information to the watching station.

Generally the watching station is found far from the field; thus, egg laying wires for transferring detector information from field to regulate station could be a expensive proposition. however the vary of battery-operated wireless devices is additionally restricted.

So, multi-hop communication is required to send information to regulate station. Researcher's area unit currently exploring the employment of multi-hop wireless detector network for this purpose.

Considering of these purposeful aspects and limitations in wireless nodes, low power, low rate wireless mesh network is found to be an honest candidate for realizing the wireless detector network testbed.

B. Wireless Mesh Networking Technology

Wireless sensors are getting a vital tool for transferral the vision of exactness farming to maturity. once deployed on fields if these sensors will kind a network among themselves mechanically then that networked sensors are expected to produce careful information on crop and soil conditions and relay that data in real time to an overseas location. Every sensing element of this network is capable of sensing and observance varied environmental conditions like temperature, humidity, pH content of soil, wetness and humus content of soil. The sensing elements with radio transceivers are capable of forming a wireless mesh network with different similar sensor nodes among its section. This wireless network is employed as a communication backbone to hold the sensing element information from the sphere to an overseas management station either directly or in multi-hop through different intermediate nodes. The sensing element information accumulated at the management station is employed for observance therefore serving to in period of time following of agriculture surroundings.

Briefly, Wireless Mesh Network of sensors primarily consists of wireless nodes integrated with sensors. These nodes have bi-directional radio transceiver through that information and management signals are communicated wirelessly within the

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network and nodes are typically battery operated. Those wireless nodes are arranged in a networking topology called "mesh". A typical mesh configuration is shown in Fig. 1.

Mesh network may be a form of network wherever every node will communicate with each alternative node through an instantaneous path or indirectly through alternative nodes. Wireless mesh networks have the subsequent characteristics:

1) they're self-forming. As nodes are hopped-up on, they mechanically enter the network.

2) they're self-healing. As a node leaves the network, the remaining nodes mechanically re-route their signals through alternative obtainable methods.

3) They support multi-hop routing. This suggests that information from a node will jump through multiple nodes before delivering its info to a number entryway or controller that will be watching the network.

The self-forming, self healing, and battery operable attributes of a mesh device network build it ideal for environmental watching applications during a wide selection of facilities [7].

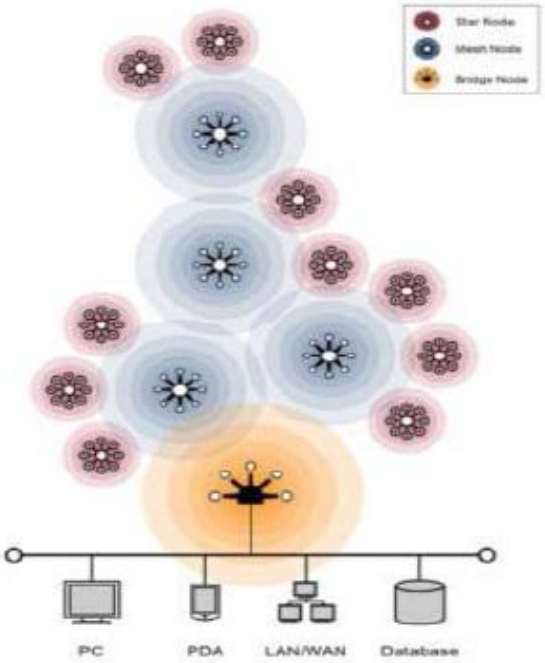


Fig.1 Wireless Mesh Network

The different wireless mesh networking protocols supported in philosophical system band is mentioned below.

Wireless computer network (IEEE 802.11) could be a versatile electronic communication protocol enforced to increase or substitute for a wired native space network, like LAN. The information measure of 802.11b is eleven Mbits and it operates at a pair of.4 gigacycle frequency.

Bluetooth (IEEE 802.15.1) could be a wireless protocol that's used for short-range communication. It uses the two.4 gigacycle radio bands to speak at one Mbit between up to eight devices. The Bluetooth is taken into account a cable replacement for mobile devices. It's principally designed to maximise the unintended networking practicality. IEEE 802.15.4 commonplace could be a physical radio specification providing for low rate property among comparatively straightforward devices that consume smallest power and usually connect over short distances. It's ideal for observance, control, and automation, sensing and trailing applications for the house, medical and industrial environments [6]. From the on top of discussion it's evident that, completely different technology choices area unit obtainable to appreciate wireless mesh network with sensors. So as to settle on the foremost economical, value effective moreover as, power-efficient technology, we'd like to review the necessities of our application. It's known that for time period observance of agricultural parameter, every sensing element node must send its detected knowledge (very low volume of data) at a periodic interval to the central management station. So, a sensing element can usually follow this schedule: it'll rouse at regular interval, sense knowledge for a short time, combination them and send it to ensuing hop and so can attend sleep once more [10].

So, appropriate routing and power management technique must be devised on the chosen technology.

In case of Bluetooth, a master will support solely seven kid nodes so it's not appropriate to support the appliance that involves many sensors to be placed around a tiny low space. However, it's doable to attain the higher than goal victimization 802.11 primarily based technologies however, those devices are typically power-hungry so not appropriate to work in outside surroundings for an extended time with battery power.

Moreover, our application doesn't need high rate (11 Mbps) supported by IEEE802.11, since lots of information measure are going to be wasted unnecessarily. quantifiability could be a major drawback in wireless fidelity accidental network. So, to support low-power, low rate, ascendible application, we tend to projected to figure on IEEE802.15.4 primarily based platform. IEEE 802.15.4.also supports more than 64000 nodes that is appropriate to handle our application

.C. Proposed System Architecture

We have designed a WIRELESS DATALOGGER

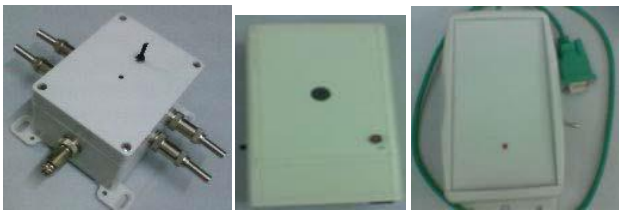
System referred to as AgroSense (Fig. 2) for remote observation of agricultural parameters. AgroSense Datalogger system consists of following four components;

1) AgroSense Wireless Datalogger unit (Fig. two a) with flexibility to connect most four differing kinds of agricultural sensors as per the necessity of a selected crop. Specifications of sensors are given in section III D.

2) Long vary Wireless Router (Fig. two b)) to relay detector information from field to remote observation station

3) Arranger (Fig. two c)) connected to a bunch laptop at the observation station to receive detector information relayed by the routers from the sphere

4) Web-based software system with easy graphical user interface and report generation facility at the observation station to produce consultative services



(a) (b) (c)

Fig. 2 AgroSense System Components

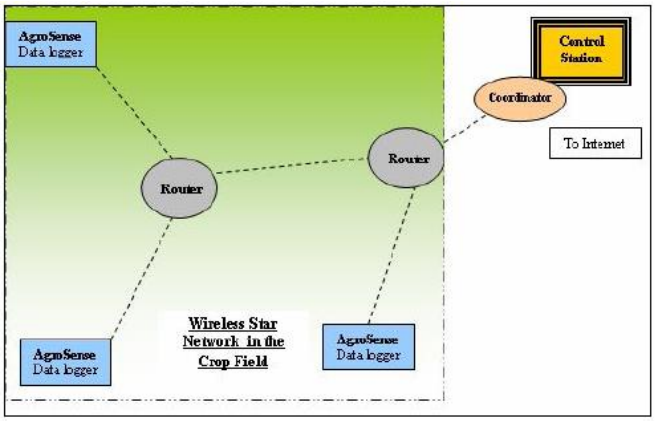


Fig. 3 AgroSense System Architecture

VI. Conclusion

A sensing system combined with IEEE 802.15.4/Zigbee based mostly wireless networking [8] has been tested to be quite effective. We've discovered that wireless transmission vary varies with wetness and setting condition. On it basis we've to style the position of routers in an exceedingly network. If doable then variety of routers ought to be accrued. The routers ought to be incased in such the way that it will tolerate explosive weather harm like rain falling, storm etc. To use this method in an exceedingly crop field or in different greenhouses, the Maxstream-Pro with whip antenna is suggested for routers. The whip antenna seldom varies just in case of vary. It's terribly troublesome for a router placed in ground level to send knowledge to a different router that is placed in ordinal or third floor of a building. Therefore in this case each the router ought to be elevated somehow to be in line of sight.

In the future, exactitude farming can gibe robotic farming as farm machinery is intended to work autonomously, ceaselessly adapting to incoming knowledge.

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Ms. Neha A. Wadaskar: Doing Master of Engineering from Sipna College of Engineering & Technology, Amravati from S.G.B.A. University in Computer Engineering field. Completed B.E. in Computer Science and Engineering field from R.T.M.N. University. Publish the research paper in National Conferences.

Dr. S. A. Ladhake: Professor at Sipna College of Engineering & Technology, Amravati. He did Ph.D, ME, P.G.D.I.T. He has more than 31 years of teaching experience. . He has published many research papers in National as well as International journal and conferences. His area of interest is MVLSI Design, Neural Networks, Multivalued Logics.