COGNITIVE RADIO IN PRECISION AGRICULTURE

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ABSTRACT:

This is an attempt to design a Precision Agriculture (PA) model, to control the required parameters in greenhouse with wireless sensor network (WSN). This prototype model of wireless sensor and actuators network is designed as per required parameters of available Crops in a greenhouse. The design of the sensor node consists of sensors, a micro-controller and a low-powered radio module. Real-time data, enable the operators to characterise the operating parameters of the greenhouse and also to respond immediately to any changes in the controlled parameters. This model has two objectives first to design the sensor node as per cognitive radio (CR) approach and aecond to study the controlling time constraints and RF interference issues in the spectrum sharing and controlling actuators.

INTRODUCTION

Agriculture is the backbone of the Indian economy and the villages are the life lines of growth of India. Agriculture is a very important sector for the sustained growth of the Indian economy. About 70 per cent of the rural households and eight per cent of urban households are still principally dependent on agriculture for employment. Since some three-quarters of the population live in rural areas, a majority of households thus depend principally on this sector. Though, industrialization of the Indian economy has adversely affected the share of agriculture in the GDP, the fact cannot be ignored that India has undergone a series of successful agricultural revolutions-starting with the 'green' revolution in wheat and rice in the 1960's and 1970's, the 'white' revolution in milk to the 'yellow' revolution in oilseeds in 1980's. As a result, India has achieved self-sufficiency in agriculture. Geographically, India is widely distributed into several agro-climatic zones, and the information need for the farming systems in these areas is entirely different. Integrating the application of available technologies to realize farmers' goals requires a systems approach to farming. It is the demand of time to improve the production of the agriculture together with the quality, which minimizes use of chemicals and fertilizers to avoid the health side effects. But nowadays the farmer only analyze the water factor for the Crop development so due to this the other factors like CO_2,Humidity,Temperature,soil conditions etc factors are not considered. So that's why the production is effectively less. To avoid all this things the farmers can concentrate on Precision Agriculture (PA) which will have the above mention parameter in consideration.

The Precision Agriculture (PA) used the few methods and technique which can monitor the required environmental parameters for the desired Crop and also analyzes the methods which can effectively control the required environment. So that we require some better technology such that we can easily control all above factors. Geographically India is divided into different agro-climate zones so with the help of green house concept the farmer can grow various Crops in different climates and various seasons. In proposed design of the green house the farmer can easily maintain the desired Crop's environment conditions.

To achieve this requirement we need the environmental parameter sensors. All theses sensor fatherly connected to server or node without wire. Such group of sensors and nodes called as WSN (wireless sensor network). With the help of such network we can easily monitor and control all the above factors. This will defiantly more help full to a PA. In a prototype green house (70m x 150 m) design for a typical Crop Capsicum, will approximately required 40-50 wireless node (sensor and actuates). If we consider more prissiness in monitoring & control the number of wireless mode may be double or triple. Again if we consider more nearby green houses this number will fatherly multiple in that ratio. But the overall server or the control room will be the unique. In such scenario the population of the wire less node will be the huge, and there will be the problem for the intercommunication between nodes and control room. Such challenges can be over come by the Cognitive radio concept which we would like to adopt for design the WSN for green house.

Precision Agriculture

This Precision Agriculture model has the potential of dramatically changing agriculture in this 21st century. Precision Agriculture lends it self to most agricultural applications and can be implemented at whatever levels are required. Precision Agriculture is based on information technology, which enables the producer to collect information and data for better decision making. Precision Agriculture is a pro-active approach that reduces some of the risk and variables common to agriculture. Precision Agriculture is more environmentally sound and is and integral part in sustaining natural resources. Precision Agriculture is considered a concept, management strategy, and even a philosophy. It is said, "Precision Agriculture is a phrase that captures the imagination of many concerned with the production of food, feed, and fiber." The concept of Precision Agriculture offers the promise of increasing productivity while decreasing production cost and minimizing environmental impacts. Precision Agriculture conjures up images of farmers overcoming the elements with computerized machinery that is precisely controlled via wireless network and local sensors and using planning software that accurately predicts Crop development. This image has been called the future of agriculture.

As a deployment of this concept in field level the green house or poly house solution are the more preferable for the farmer or the grower. Before going for the green house design grower has to first required to survey for climatic condition of that desired area of field. This can be monitor by wireless whether station. A typical outcome of the on line wireless whether station is listed in following table.

	Time	Wind	Dir	Temp	Press	Humidity	Light	CO_2
1	100112-10:45:20	18	NE	31.8	99.0	65%	55.5	0.03%
2	100112-11:00:10	19	E	32.5	99.2	65%	51	0.03%
3	100112-11:15:22	20	E	32.8	98.5	70%	52	0.03%
4	100112-11:30:12	20	NE	33.8	98.4	60%	53	0.03%
5	100112-11:45:09	16	NE	34.6	97.5	62%	53	0.03%
6	100112-12:00:18	10	E	35.5	97.5	63%	55	0.03%

Table 1: Weather station typical samples on 12 Jan 2010.

Table 1 shows the reading of the climatic condition at 19^o 23' 08.62" N 74^o 38' 34.66" E on date 12 Jan 2010 this data is available through "Mahatma Phule University of Agriculture, Rahuri"

On the other side grower or farmer has to require the select the Crop of his interest. While the selection for Crop it is required to study the data sheet or grower fact for that Crop. One the typical Crop data sheet and the required parameters value at different stages of the Crop is given below. This information is collected from Ball Seed Co.'s website

Condition	**I**	**II**	**III**	**IV**	**Growing**	**Post Prod.**
Temp(D)	--	--	--	--	18-21	16-21
Humidity(D)	--	--	--	--	65-70	55-65
Light(D)	--	1-2.5K	--	--	--	Full Sun
Pressure(A)	--	--	--	--	--	--
Temp(N)	--	--	--	--	17-18	13-18
Humidity(N)	--	--	--	--	62-65	60-70
CO2(A)	--	--	--	--	--	--
pH(Soil)	5.5-5.8	5.5-5.8	5.5-5.8	5.5-5.8	5.5-6.5	--
Humidity(S)	75-78	70-75	65-70	60-62	--	--
Temp(S)	24-26	21-24	18-21	16-17	--	--
Fertilizer ppm	--	50-75	100-150	1401415515	--	--
Ammonium	>10ppm	>10ppm	--	--	--	--
Sol. salt(EC) in m mhos	0.5	>0.75	>0.75	>0.75	1.0	--

Table 2. Desired environmental parameter for typical Crop

Green House Design

The purpose of a greenhouse used on Earth is to provide a confined space maintained at desirable environmental conditions for plant growth. The types of structures that might be used for plant production on Mars vary from small automatically deployed structures for research purposes to larger structures that would be used to grow plants as part of a manned expedition. The structural requirements will vary depending on the size and purpose of greenhouses, but the functions necessary for successful plant growth will be similar regardless of size. Our goal is design concepts for small automatically deployed structures. You need land, preferably three acres or more, as well as a good water supply, access to major, roads, friendly zoning laws, reasonable taxes and plenty of sunlight. Many locations will do it the above factors are favorable. Location is more critical if you live in an urban area and anticipate a retail market than in a rural area. Many current greenhouse owners are facing new zoning, pesticide use restriction and taxation problems that could easily cause concern to a new greenhouse business owner. The basic growing structure has changed over the past decade. “Even-span” and “Quonset” poly-covered greenhouses still predominate and are a wise, low-cost choice for the beginner. Relative newcomers to U.S. greenhouse construction are rigid double plastic (structured sheets). The principal materials are acrylic, polycarbonate, and combinations of the two. They are fuel efficient (because of double wall construction), offer good light transmission, and have a lifespan of 10 years or more.

There are many items to consider when contemplating the location and design of a greenhouse. These include, but are not limited to, the following:

- Site selection and access.
- Greenhouse orientation for optimum light utilization.
- Structural strength to handle weather conditions, including wind and snow.
- Suitable greenhouse glazing materials, including plastic film, rigid plastic panels, glass.
- Energy conservation considerations, e.g., double-layer glazing, curtain systems.
- Environmental control systems, e.g., heating, ventilation, lighting, CO_2 enrichment.

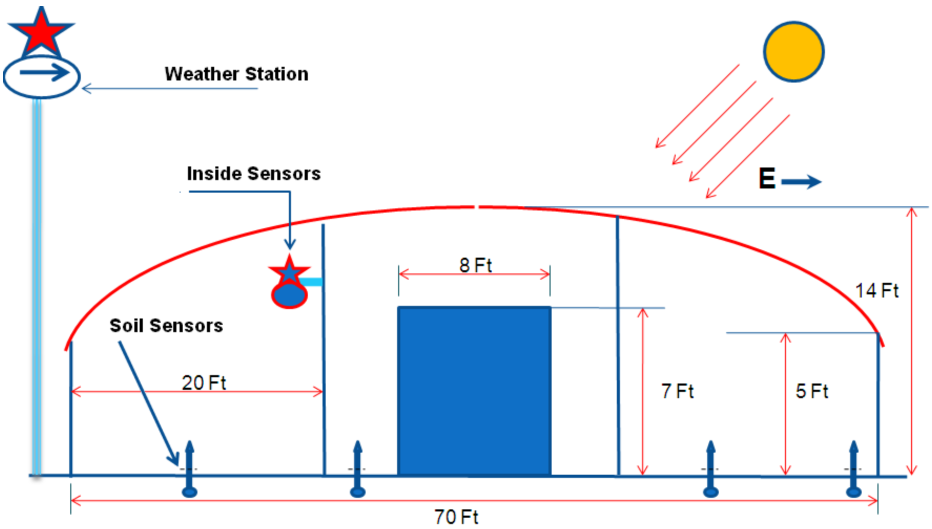

Fig 1. Green House and Sensors

A site survey that includes a topographical map is important so that there are no surprises with runoff, quantities of required back fill, road access, or local zoning regulations. The elevations shown on the map should have a minimum of 1-foot contour intervals. The site plan should accurately show the property and indicate current buildings, roads, and locations of all utilities. Locations of streams, ponds, and dedicated wetlands are important for runoff considerations as well as the permitting process. If a retail operation is part of the design plan, then more care is needed in planning to satisfy building code, public safety, and zoning regulation and market study. Required the good planning for arrange the sales area so that employee and plant material movement do not intersect and interrupt normal customer movement and traffic patterns. Key Components of the Permanent greenhouse facilities are often constructed with a solid concrete foundation. Structural foundation footers and/or walls must extend below the frost line and perimeter walls should be insulated to prevent unnecessary heat loss to the outside environment bordering the greenhouse perimeter. Main interior concrete walkways should be at least 4 inches thick and 10 feet wide to accommodate vehicular traffic.

Structure: - The type of greenhouse structure should be based on the Crops to be grown, the growing system used, the level of automation, the amount and location of equipment used, and the overall physical arrangement possible on the site. These variables determine bay width and length, gutter height, type of glazing, type of ventilation, etc. Use of supplemental lighting, shade/energy curtains, and production of hanging baskets can determine gutter height. In addition, irrigation booms may require additional vertical clearances.

Ventilation and Cooling System: - Ventilation systems can be either mechanical or natural (i.e., without the use of fans to move air through the greenhouse). The use of natural ventilation is mostly determined by the average wind conditions at the site. When there is virtually no wind, air circulation depends primarily on the buoyancy of hotter air in the greenhouse rising out of the ventilation outlets (roof vents) and drawing air in through the ventilation inlets (side vents). Natural ventilation using side and roof vents is a popular choice, as is the novel open-roof greenhouse design, but their appropriateness depends on the Crops being grown, local weather conditions, and grower preferences.

Heating System: - The heating system should be selected based on the Crops being grown, heating uniformity criteria, fuel availability and cost, and grower preferences. The initial installation cost is important but should not be the most important consideration. Uniform Crop growth is very important for most production systems, and the heating and ventilation systems have a major impact on producing uniform Crops. Heating systems that give good temperature uniformity are preferred (e.g., circulating hot-water heating systems, floor and bench heating systems). Forced hot air systems generally have lower initial costs but decreased heating efficiency and less satisfactory uniformity will generally reduce long-term profitability.

Thermal Screens or Curtain Systems: - A thermal screen that doubles as a shade screen is often one of the best investments a grower can make. The design of the greenhouse structure must be able to accommodate a thermal screen (i.e., enough space is needed between the top of the plant canopy and the greenhouse roof to accommodate the operation of a thermal/shade screen). If the installation cannot be included at the start of a greenhouse construction project, the design must include provisions for it to be added without expensive modification or alteration to the greenhouse at a later date. It is important to also consider the possible future addition of supplemental lighting and/or movable irrigation systems when deciding on the initial greenhouse height. Some greenhouse operations had to be reconstructed one or more times over their life to accommodate improvements and the marginal cost of several extra feet of height in initial construction are modest.

Growing Systems: - Efficient use of greenhouse space is a major consideration for growers. Being able to fill and empty the greenhouse efficiently and quickly is very important. Here, mechanization can help. The bedding plant industry is a good example of the importance of mechanization. Each piece of equipment is part of a system used to achieve the desired goal of efficient movement at reduced time commitment, effort, and cost. Speedy removal of the Crop from the greenhouse may require the use of an overhead conveyance to bring the plant material to a main walkway.

Environmental Control System: - Quality analog and digital (computer) systems are available that accurately sense and control both aerial and media (soil) conditions. Common measurements include air, canopy, and root-zone temperatures, sunlight (often measured as photosynthetically active radiation), and relative humidity of the greenhouse air, aerial carbon dioxide concentration, electrical conductivity and pH of the nutrient solution and/or media. In addition, measurements such as ventilation window position, ventilation fan runtime, operation of pumps, position of mixing valves, nutrient solution volume, etc., are used to keep track of equipment operation. Computerized control systems have the advantage of recording data for subsequent use in evaluating plant performance or identifying problems with the mechanical aspects of the growing system. Adequate Water Supply In sitting a greenhouse, consideration must be given to the availability of water. Is there an adequate water supply? And what is the water quality? Does it make sense to capture the runoff from the roof and store it for irrigation? In some areas of New Jersey water availability may be a limiting factor for greenhouse establishment and production. All users of agricultural or horticultural water that exceed a usage of 100,000 gallons per day must obtain an agricultural certification for the privilege of diverting water from ground or surface sources. The Rutgers Cooperative Research and Extension agricultural agent in your county can assist in determining water use requirements for your operation and the application process for certification.

Irrigation Systems: - Irrigation systems vary in design and layout. Automation is a major consideration. Thus, a greenhouse design should be chosen that allows for (future) installations of automated control and autonomously operated equipment.

Greenhouses need to be heated, cooled, or ventilated depending upon the time of the year. These systems need to be integrated to obtain maximum efficiency. Heat can be provided by central boilers generating hot water or steam, or by individual unit heaters hung in the greenhouse. Fuels used to fire the heaters or boilers are natural gas or liquid propane. Electric heat is prohibitively expensive. If boilers are used, smaller multiple boilers are preferred over one large boiler capable of heating the entire range. Multiple units allow for zoning and can provide minimal heat requirements in case one boiler fails. Steam or hot water is distributed through the greenhouses in a radiant heat pipe system. Unit heaters are gas-fired, or operate from steam or hot water generated in a central boiler room.

Unit heaters are located at gutter height in the greenhouses. Warmed air from the unit heaters or radiant pipes is distributed by means of horizontal air flow fans or polyethylene tube systems. Regardless of the heating system utilized, thermal curtains can be installed to insulate the greenhouse from extremely low nighttime winter temperatures. These are normally installed at gutter height and span across the greenhouse. Installation of thermal or heat retention systems will have an influence on the selection of the green house structure.

The horizontal air flow fans or polyethylene tube (fan-jet) systems are also used to recirculate air when no additional heating or cooling is needed. Air circulation throughout the greenhouse is important to prevent hot or cold spots, and to minimize disease problems resulting from high humidity pockets developing about the plant canopy.

Greenhouses need to be equipped with exhaust fans to exchange inside and outside air, and to equalize temperatures within the greenhouse. To reduce green house temperatures on sunny winter days, an inlet louver is installed adjacent to the fan-jet system. This inlet louver will open to draw in fresh, cool outside air and is circulated through the fanjet system. To reduce summer greenhouse temperatures, exhaust fans used in conjunction with evaporative cooling pads (made from corrugated cellulose) are necessary. The energy required to evaporate water from the pads cools the air drawn across the pads helping to reduce the interior greenhouse temperatures.

Storage and Work Space: - Warehouse storage and work space is often overlooked in designing a new business. Without storage and work space, material costs increase and labor becomes inefficient. Bales of peat moss and pre-mixed potting media should both be stored out of the sun and weather, because the plastic packaging may split with exposure to ultraviolet rays from the sun. Cardboard boxes disintegrate in the rain. Fertilizer forms hard clumps from moisture. A separate space for chemical storage is needed, and it must be constructed to meet current governmental requirements. Work space is required to mix potting media, fill pots, potting and transplanting activities, and place plants sold and waiting to be delivered, and to load or unload trucks out of the weather. A most efficient space design is one where storage is located adjacent to the work space, reducing the distance materials must be transported.

Wireless Sensors and Accouters in Green House

Precision farming needs information about mean characteristics of small, relatively homogeneous management zones. This is for Data acquisition of the farms to find the soil, vegetation and other above describe parameters that are amenable for remote/wireless sensing. Wireless sensing techniques play an important role in precision farming by providing continuous acquired data of agricultural Crops. Wireless sensors for PA, which is growing on different soil types with different water availability, substrate, impact of cultivation, and relief Sensors use for the following applications:

- **Soil Properties Sensing:** Soil Texture, Structure, and Physical Condition Soil Moisture; Soil Nutrients, Fertilizer flow; Weed detection, pressure sensors.

- **Plant Population**; Crop Stress and Nutrient Status. Yield Monitoring Systems: Crop Yield; Harvest Swath Width;
- **Current Climatic condition monitoring**: Air temperature, air flow, air pressure, air moisture,
- **Desired Climatic and soil condition for the Crop:** The study of Crop life cycle at different stages of the Crop is required. This information can be collect from the seed manufacture's website of data base. This information is available in forms of Crop data sheet, grower's fact sheet and Information Boucher of that verity of Crop. .
- **Some of the other studies include**: Crop condition assessment, Agricultural drought assessment, Pests and diseases, Land capability and irrigability

A recent survey [1] of the advances in wireless sensor network applications has reviewed a wide range of applications for these networks and identified agriculture as a potential area of deployment together with a review of the factors influencing the design of sensor networks for this application. The basic components of a sensor network consist of one or several sensors that are connected to a micro-controller and a radio module. When a large number of these tiny sensor nodes are deployed either randomly or in regular grid, they shall act collectively to perform sensing over a large area or in inaccessible terrains. Intel Corp. was one of the main proponents of the use of wireless sensor networks for agriculture with a study in 2002 which assessed the potential for sensor networks and a trial installation of 18 temperature sensor nodes for a period of several weeks in an Oregon vineyard. Its main application was to monitor the temperatures during the winter nights and to determine the time to pick the grapes. This was followed by another project with 65 temperature sensor nodes arranged in a grid with a fixed network topology to determine the duration of exposure to extreme cold and to correlate the recorded temperatures to the ripening parameters. Research on the use of WSN in agriculture is mainly focused on two major areas:

(i) Experimental or simulation work on various routing protocols and network topologies to increase data transfer rates whilst maintaining or reducing power consumption
(ii) Proof-of-concept applications to demonstrate the efficiency and efficacy of using sensor networks to monitor and control agriculture management strategies.

Precision Agriculture (PA), using computers, sensors and other information technology, potentially allows producers to automate site-specific management for mechanized agriculture. The relatively slow adoption of PA (Lowenberg-DeBoer, 1998; Khanna et al, 1999, Daberkow and McBride, 2000) has raised questions about the farm level benefits of this technology. Precision farming is characterized by a number of sophisticated tools that assist in monitoring variation and managing inputs. These include:

- Global Positioning System (GPS) – a referencing device capable of identifying sites within a field;
- Sensors and dataloggers – Crop, soil and climate information can be monitored at a high frequency using these technologies

- Geographic Information Systems (GIS) – maps of these attributes can be generated and analyzed using simple browsers or complex models;

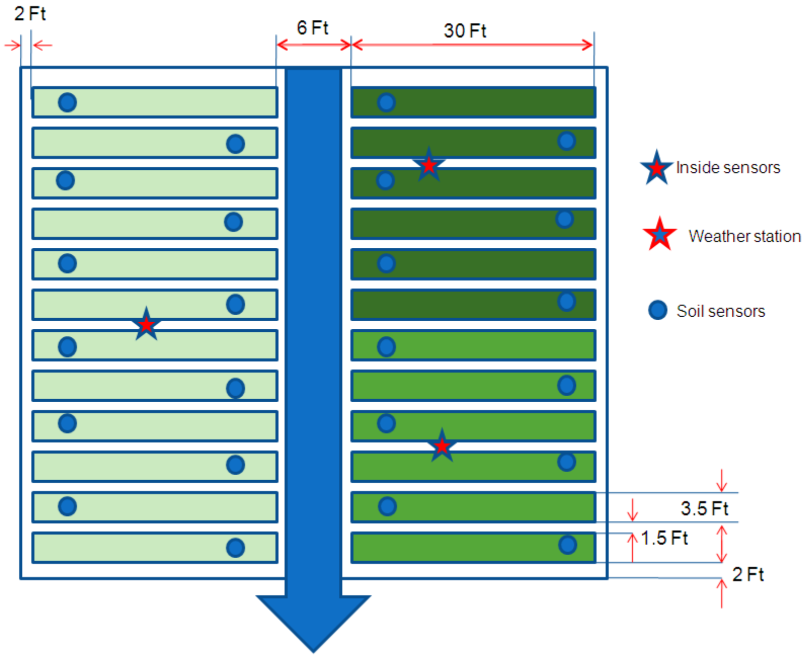

Fig. 2 Precision Farming overview and sensor location plan

Differential action – once the factors that are limiting yield are identified, action can be taken to overcome or minimize these constraints. The key components of Precision Farming include capturing the data at an appropriate scale and frequency, interpretation and analysis of that data, and implementation of a management response at an appropriate scale and time. In fact, the key differentiator between the conventional management system and Precision Agriculture is the application of modern information technologies towards providing, processing and analyzing the multi-source data of high spatial and temporal resolution for decision-making and operations in the management of Crop production.

One of the samples of the whether station wireless sensors data in tabulated format are shown in Table 1 and the other sensors (inside sensor and soil sensors) which are mention in Fig 1 & 2 are given bellow table 4 & 5 respectively. Inside sensor are placed to monitor the green house inside environment's parameter. This can be place at 2-3 places in the green house. The soil sensors are monitor the soil conditions. These are places at least 2-3 meter long across the line of plants in green house. One part of soil sensors are the placed under ground and the other part (antenna and controller circuit) at outside the soil to communicate with server node.

Time	Temp	Pressure	Humidity	Light	CO_2
100112-10:45:21	28.8	84	88%	35	2.6%
100112-11:00:34	29.5	81	85%	35	2.6%
100112-11:15:28	29.6	80	84%	40	2.6%

Table 3 Sensor "Inside Climate" on 12 Jan 2010 sensor ID B003

Time	Temp	Humidity	PH	Elect. Conductivity

100112-10:45:22	25.8	83%	5.5-6.5	0.76 mhos
100112-11:15:16	28.0	85%	5.5-7.0	0.78 mhos

Table 4 Sensor "Soil Sensor" on 12 Jan 2010 sensor ID C0105 at B9

Date-time	Sen. ID	Location	L	Data in Hex	Valid
100112-10:45:20	A0001	12.0,30.5	8	BD 04 A2 65 12 54 45 3E	Y
100112-10:45:21	B0001	D9	5	D4 F2 15 34 9A	Y
100112-10:45:21	B0002	C2	5	D5 F2 13 34 9B	N
100112-10:45:22	B0003	F8	5	D5 F2 15 32 9B	Y
100112-10:45:22	C0023	A5	4	C7 5B 83 A9	Y
100112-10:45:22	C2034	B6	4	C5 59 8A A7	N
			4	BF 45 75 9D	Y

Table 5 Data Collected at server end by different wireless sensors

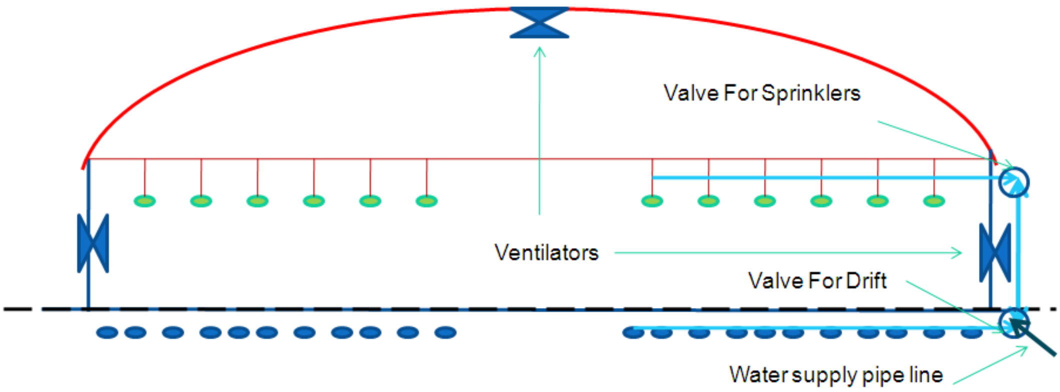

Fig 4. Proposed Accouters in a typical Green House

Based on the data collection by the wireless sensors from the green house and Crop's desired requirements there has to be few accouters like irrigation valve, ventilation fans, heated, cooler etc. This sensors data and controlling accouters will help to achieve the goal of environment control. Each wireless sensor and the wireless accouters be a node of WSN. To maintain precisely controlled environment is depend on the population of WSN node.

Cognitive Radio

The idea of cognitive radio was first presented officially in an article by Joseph Mitola III and Gerald Q. Maguire, Jr in 1999.[1] It was a novel approach in wireless communications that Mitola later described as: The point in which wireless personal digital assistants (PDAs) and the related networks are sufficiently computationally intelligent about radio resources and related computer-to-computer communications to detect user communications needs as a function of use context, and to provide radio resources and wireless services most appropriate to those needs.[2]

It was thought of as an ideal goal towards which a software-defined radio platform should evolve: a fully reconfigurable wireless black-box that automatically changes its communication variables in response to network and user demands.

Regulatory bodies in various countries (including the Federal Communications Commission in the United States, and of com in the United

Kingdom) found that most of the radio frequency spectrum was inefficiently utilized. [3] For example, cellular network bands are overloaded in most parts of the world, but amateur radio and paging frequencies are not. Independent studies performed in some countries confirmed that observation, [4] [5] and concluded that spectrum utilization depends strongly on time and place. Moreover, fixed spectrum allocation prevents rarely used frequencies (those assigned to specific services) from being used by unlicensed users, even when their transmissions would not interfere at all with the assigned service. This was the reason for allowing unlicensed users to utilize licensed bands whenever it would not cause any interference (by avoiding them whenever legitimate user presence is sensed). This paradigm for wireless communication is known as cognitive radio Terminology

Depending on the set of parameters taken into account in deciding on transmission and reception changes, and for historical reasons, we can distinguish certain types of cognitive radio. The main two are:

(i) Full Cognitive Radio ("Mitola radio"): in which every possible parameter observable by a wireless node or network is taken into account.[6]

(ii) Spectrum Sensing Cognitive Radio: in which only the radio frequency spectrum is considered.[7]

Also, depending on the parts of the spectrum available for cognitive radio, we can distinguish: *Licensed Band Cognitive Radio* in which cognitive radio is capable of using bands assigned to licensed users, apart from unlicensed bands, such as U-NII band or ISM band. The IEEE 802.22 working group is developing a standard for wireless regional area network (WRAN) which will operate in unused television channels. [8][9]

Unlicensed Band Cognitive Radio which can only utilize unlicensed parts of radio frequency spectrum.[citation needed] One such system is described in the IEEE 802.15 Task group 2 specification.[10] which focuses on the coexistence of IEEE 802.11 and Bluetooth.[citation needed]. There are several application for wireless sensors, Communication and all are using ISM (unlicensed band is called ISM (Industries Scientific Medical) band application. This band of frequency is reserved for these domain applications; our design is also fall in this band.

Protocol for WSN for Green House

As per the research carried out by Wendi Beth Heinzelman (Application-Specific Protocol architectures for Wireless networks) it can be concluded that the special or the customize protocol are prefer to use for different WSN and the application. That is the application based protocol is the good approach for designing the WSN for green house. Based on the above discussion and the exact required controlling parameters, type of sensors and the pupation for the sensors are major deciding factors for the protocols. Apart from this the communication carrier frequency targeted areas, microcontrollers, RTOS and RF radio will be also a deciding factors.

Micro sensors are equipped with sensor module capable of sensing some quantity about the environment, a processor for processing the signals from the sensor and performing network protocol functions, a radio module for communication, and a battery to provide energy for operation. A given sensor’s view of the environment is limited both in range and in accuracy; it can only cover a limited physical area of the environment and depending on the firmware, protocols used and the time synchronizations while communication may produce data error. Data from sensor networks are typically time-sensitive, so it is important to receive the data in a timely manner.

The iRF group designed the three different wireless sensors for agriculture use; these are describe in above discussion. These sensors are used iRF module which included Cypress CiFy radio and support the flexibility to used customized protocols using PSoC platform. These sensors are developed and under process to adopted the cognitive radio concepts in wireless sensors network in green house. This system will be fully reconfigurable as per the Crop's growing facts, environmental monitoring and controlling parameters. There is the further scope for develop a special RTOS which can work on PDA/sever to monitor the facts of green house.

CONCLUSION

The study of the wireless sensor network for precision agriculture is the priority research objective for India. It will help the nation to increase the present scenario of the farmer's economical growth. Using this technology we can optimize the use of resources like water, manpower, time, spectrum utilization. After success of this objective we can grow the various crops in India which is not done before due to limitations of climatic conditions. It will also help to increase the quality and production of crops.

Considering the challenges raised by cognitive radio, the use of the wireless sensor networks appears as a crucial need to achieve satisfactory results in terms of efficient use of available spectrum and limited interference with the licensed user. As described in this paper, the development of the Sensor Network aided Cognitive Radio technology requires the involment and interaction of many advanced techniques, including distributed spectrum sensing, interference management, cognitive radio reconfiguration management, cooperative configuration communication, end to end protocol design. Our objective is to promote the development of the technology by providing significant theoretical results and associated simulations in the relevant areas.

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