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Smart Sensor System for Agricultural Chronology

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Abstract— **The upsurge in the expansion of technology and new scientific innovations extended its boom even in farming, coining "precision agriculture". Hitherto, the agricultural practices followed by the farmers are arduous, involving a great physical effort from the side of farmers. The usage of different kinds of sensors and their efficient way of networking in the agricultural fields, eases the work of farmers in the cultivation. This in turn, improves the quality of food grains, reduction in the use of the pesticides and fertilizers, optimal usage of natural resources, thereby increasing the overall profits of the farmers. Here we are taking into account some of the problems like wastage of the natural resources, power management in the wireless sensor networking (WSN). For the identified problems, we are thereby proposing some of the ideas concerning the sensors that could effectively procure the information regarding temperature, humidity and soil moisture and also some of the Bio-sensors for detecting the nutrients content in the soil of the agricultural fields. Also, we discussed the building up of an architecture for the networking of these sensors, along with the specifications of the components being used as a part of this smart sensor system. Thus the hardware platform is touched, by considering the features of different micro-controllers for acquiring the sensor information in real time, processing, sending and receiving information from fields to the farmers through SMS. The expected results of this paper will reflect the optimal use of water and electricity, increased quality of food grains, reduced usage of pesticides and fertilizers, and thus reduced environmental pollution besides easing the work of farmers.**

Keywords— **Precision agriculture, Wireless Sensor Networking, Bio-sensors, Micro-controllers, SMS**

I. Introduction

The on-going developments in the miniaturization of electronic devices and wireless communication technology have lead to the emergence of an energy efficient Wireless Sensor Networks (WSN), making it possible to acquire the field information more timely, accurately and conveniently. Also due to the fast development in the telecommunication technologies, it is believed that wireless communication along with Global System for Mobile communication (GSM) and Short Message Service (SMS) is alleged to be a good practice for remote sensing in the agricultural fields. We conducted a field survey in our nearby agricultural farms of vaddeswaram (Guntur Dst.), where most of the farmers relied on the crops like paddy, banana and turmeric. We studied and sorted out some of necessities of these crops as per the information given by the farmers around. Based on this, we have cited mainly three sensors, to be exact, Humidity, Temperature and soil moisture sensors besides the Bio-sensors. We are there by putting forward an architecture for the networking of these sensors, through which the data is transmitted from the sensors to the base station, from where alerts regarding the field parameters to be scrutinized, can be sent to the farmer through SMS. We presented the concept of data-loggers to which the sensors are connected so that the data is relayed to them from these sensors. The data thus collected can be acquired by the remote Base Station through the wireless sensor networking that has been stated with a well-defined architecture.

II. Component Description

A. Temperature Sensor

We flicked through some of the Temperature sensors like LM20, LM34, LM35, LM94022, LM94023, THERM200 which are locally available low cost sensors with a wide range of specifications that would suit the farms around. Among these we are now suggesting here THERM200, bearing in mind the necessities that have been drawn under the field survey, which consumes low current besides being economical.

The THERM200 is a soil temperature probe, which has a temperature span from -40°C to 85°C. It outputs a voltage linearly proportional to the temperature, so no complex equations are required, to calculate the temperature from voltage. It is highly accurate with 0.125°C of resolution. The sensor has a simple 3 wire interface: ground, power, and output, and is powered from 3.3V to 20VDC, and outputs a voltage 0 to 3V. Where 0 represents -40°C and 3V represents 85°. The probes can be buried, or inserted into pots. Since the blade is so narrow, it can easily be inserted into potted plants. Thermistor based temperature sensors, are typically inaccurate, and use the complex Steinhart-Hart equation which contains complex calculations such as logarithmic and third order terms, which are difficult for microcontrollers to compute, we can overcome this difficulty with the use of THERM200.

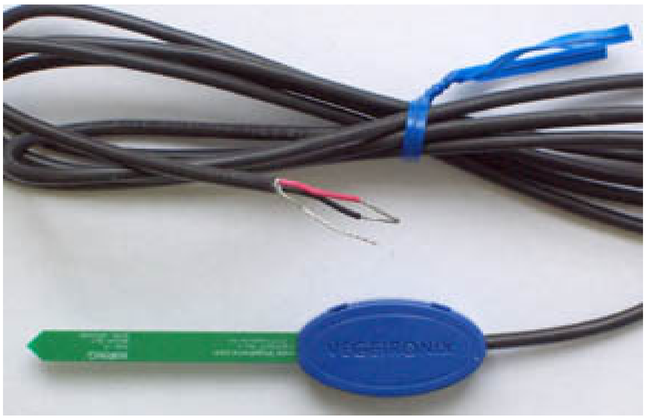

Fig. 1 THERM200 Temperature Sensor

The Soil Temperature Sensor Probe Features :

- Low cost, no need to calibrate and is of small size.
- Consumes less than 3mA for very low power operation with a wide supply voltage range.
- Precise measurements and no complex Steinhart-Hart are needed to convert voltage to temperature.
- Can be buried and is water proof with a rugged design for long term use.
- Probe is long and slender for wider use, including smaller potted plants.

TABLE I

SOIL TEMPERATURE SENSOR PROBE SPECIFICATIONS

THERM200 Temperature Sensor Probe	
Supply Voltage	3.3V to 20 VDC.
Power on to Output stable	2 seconds
Output Impedance	100K ohms
Operational Temperature	-40ºC to 85ºC
Accuracy	±0.5°C
Output Voltage Range	0 to 2.44 linear to temperature
Voltage Output Equation	Temperature (ºC) = Vout*41.67 -40
Cable Length	2 meters

TABLE II

SOIL TEMPERATURE SENSOR PROBE WIRING TABLE

Bare	Ground
Red	POWER: 3.3V to 20 VDC.
Black	OUT: 0 to 2.44 linear to temperature

B. Humidity Sensor

To measure humidity, amount of water molecules dissolved in the air of poly-house environments, a smart humidity sensor module SY-HS-220 is opted for the system under design. The humidity sensor is equipped along with signal conditioning stages, as a conditioning signal circuit is to used in order to change the variable capacitance of the sensor into a usable voltage. A capacitive humidity sensor changes its capacitance based on the relative humidity (RH) of the surrounding air. Relative humidity (RH) is the percentage of actual vapor pressure (P) compared to saturated vapor pressure (Ps). As the relative humidity increases the capacitance also increases. The humidity sensor is of capacitive type, which is a capacitor with at least two electrodes, between which a humidity sensitive dielectric is located. At least one of the two electrodes, which can consist of a differently shaped metallic layer, is provided on an electrically highly insulating support which preferably consists of glass or ceramic and is frequently referred to as a substrate. The second electrode, outwardly located and likewise designed as a metallic layer, is permeable to moisture, especially to water vapor, i.e. the water molecules in the air can diffuse through it. Between these two electrode layers is the humidity-sensitive dielectric, critical for humidity measurement. In these humidity sensors generally a polymer film is used as the dielectric layer. The change in capacitance of a humidity sensor of this kind in the presence of air with different moisture content is based on the fact that the water molecules in the air diffuse into the polymer forming the dielectric, changing the dielectric constant (DC) and thus the capacitance of the resultant capacitor. While the dielectric constant of polymers is between 2 and 3, the dielectric constant of water is 80. This means that when water molecules penetrate the dielectric layer, the capacitance of a capacitor that can be used to measure humidity, increases. However, it is mounted on the PCB, which also consists of other stages employed to make sensor rather more smart The PCB consists of CMOS timers to pulse the sensor to provide output voltage. Moreover, it also consists of oscillator, AC amplifier, frequency to voltage converter and precision rectifiers. Incorporation of such stages on the board significantly helps to enhance the performance of the sensor. Moreover, it also helps to provide impediment to the noise. The humidity sensor used in this system is highly precise and reliable. It provides DC voltage depending upon humidity of the surrounding in RH%. This work with +5 Volt power supply and the typical current consumption is less than 3 mA. The operating humidity range is 30% RH to 90% RH. The standard DC output voltage provided at 250C is 1980 mV . The accuracy is ± 5% RH at 250C. It provides three pins recognized as B, W and R. The pin labeled W provides the DC output voltage, where as the pin labeled B is ground. The VCC of +5V is applied at the pin R. The humidity dependent voltage is obtained and subjected for further processing

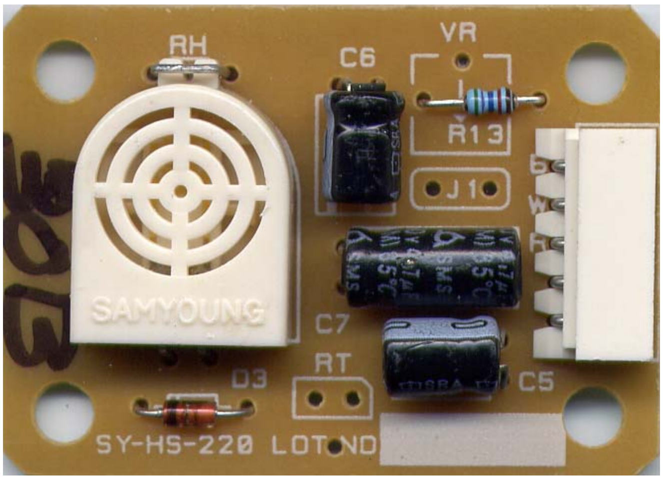

Fig. 2 SY-HS-220 Humidity sensor

It is found that humidity sensor SY-HS-220 produces the Dc output voltage 1980 mV at 250C and 60% RH. This voltage is the offset voltage (Voffset). Therefore, one has to compensate this offset voltage. The offset voltage compensator is designed about operational amplifier 741 and presented in Figure. The compensating voltage (VC), equal in magnitude and opposite in sign to that of offset voltage (Voffset), is added so that the offset voltage will be compensated. The amplifier has unit gain. Hence, the output voltage (V0) can be expressed as

V0 = VRH + Voffset

VRH = V0 – Voffset=V0 -VC. …(1)

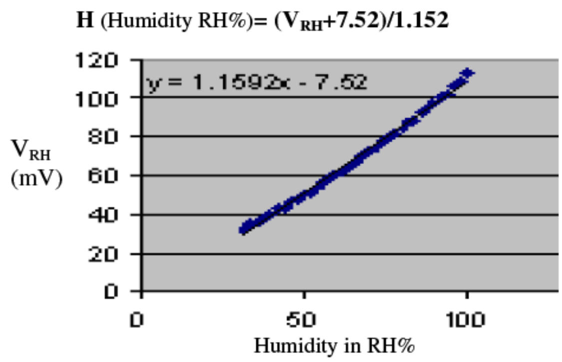

Fig. 3 Graph plotted between V_{RH} and their corresponding Humidity values

Where, VRH is the humidity dependent voltage. At normal conditions the output voltage is equal to offset voltage. Therefore, the resulting voltage is zero. However, for all conditions other than normal the output voltage V0 deviates from the offset voltage. Therefore, it results the humidity dependent DC voltage VRH. This voltage is in mV range. This VRH is then subjected to the microcontroller of our data-logger.

C. Soil Moisture Sensor

Measuring soil moisture is important in agriculture to help farmers manage their irrigation systems more efficiently. Analysis of information regarding soil moisture not only lessens the amount of water consumption to grow a crop, but also increases the yield and the quality of the crop by better management of soil moisture during critical plant growth stages by the farmer. We are proposing the implementation of a high frequency VH400 series moisture sensor probes which enable precise low cost monitoring of soil water content suiting our purpose. Because this probe measures the dielectric constant of the soil using transmission line techniques, it is insensitive to water salinity, and will not corrode over time as does conductivity based probes. These probes are small, rugged, and low power. Compared to other low cost sensor such as gypsum block sensors, these probes offer a rapid response time. They can be inserted and take an accurate reading in under 1 second. It is even much sensitive at higher VWC levels, and it's curves are more linear. Probes come standard with a 2 meter cable.

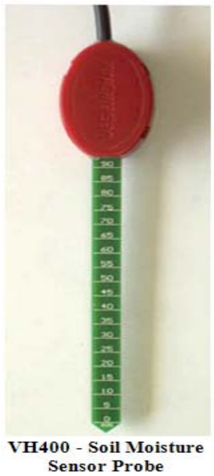

Fig. 4 VH400-Soil Moisture Sensor Probe

Soil Moisture Sensor Probe Features :

- Extreme low cost with volume pricing.
- Not conductivity based.
- Insensitive to salinity.
- Probe does not corrode over time.
- Rugged design for long term use.
- Small size.
- Consumes less than 600uA for very low power operation.
- Precise measurement.
- Measures volumetric water content (VWC) or gravimetric water content (GWC).
- Patent pending technology**.**

- Output Voltage is proportional to moisture level.
- Wide supply voltage range.
- Can be buried and is water proof.
- Probe is long and slender for wider use, including smaller potted plants.

TABLE III

SOIL MOISTURE SENSOR PROBE SPECIFICATIONS

VH400 Sensor	
Power consumption	< 7mA
Supply Voltage	3.3V to 20 VDC.
Dimensions	See drawing below.
Power on to Output stable	400 ms
Output Impedance	100K ohms
Operational Temperature	-40ºC to 85ºC
Accuracy	< 1%
Output	0 to 3V related to moisture content
Shell Color	Red

TABLE IV

SOIL MOISTURE SENSOR PROBE WIRING TABLE

Bare	Ground
Red	POWER: 3.3V to 20 VDC.
Black	OUT: (0 to 3V related to moisture content.)

The volumetric water content for the respective voltages can be obtained from the below curve plotted between the VWC and their voltages which are the outputs of the soil moisture probe.

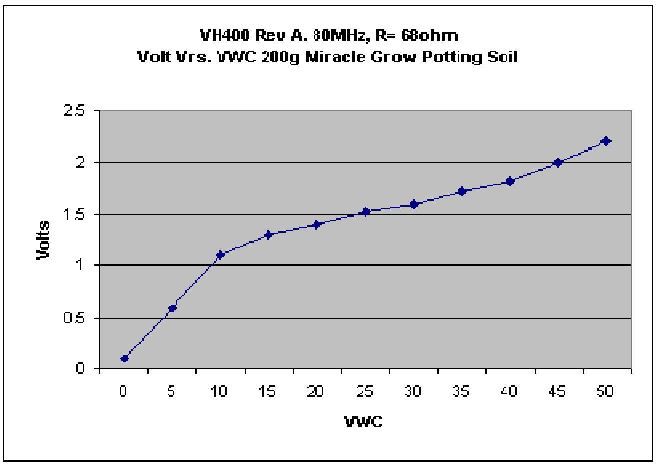

Fig. 5 VH400 Piecewise Curve

Most curves can be approximated with linear segments of the form: y= mx-b,

where m is the slope of the line

The VH400's Voltage to VWC curve can be approximated with 4 segments of the form:

VWC= mV-b

m= (VWC2 - VWC1)/(V2-V1)

After m is determined, the y-axis intercept coefficient b can be found by inserting one of the end points into the equation: b= mV-VWC

TABLE V

VOLTAGE RANGES AND THEIR RESPECTIVE EQUATIONS

Voltage Range	Equation
0 to 1.1V	VWC= 10V-1
1.1V to 1.3V	VWC= 25V- 17.5
1.3V to 1.82V	VWC= 48.08V- 47.5
1.82V to 2.2V	VWC= 26.32V- 7.89

D. Data loggers

Data logging and recording is a very common measurement application. In its most basic form, data logging is the measurement and recording of physical or electrical parameters over a period of time. Here we are using these data loggers for acquiring data from the different sensors we used in the field (temperature, soil moisture, humidity).The data logger we use is a simple equipment built up by a precision analog to digital converter with 8051 microcontroller and flash memory(MSC1210). Different sensors we use are connected to the analog input ports of MSC1210. ZigBee is used to transmit the data from data loggers to the base station.

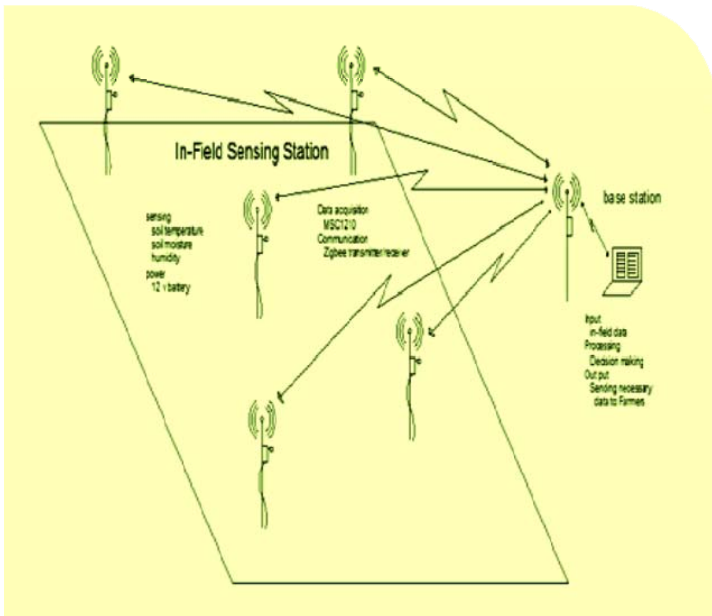

Fig. 6 Implementation Of Data-Loggers In The Agricultural Field

The data logger together with the sensors can be termed as a sensor node, which comprises of the sensors, data logger and the ZigBee transmission module for the wireless transmission of the data. This sensor node can be represented as shown below: .

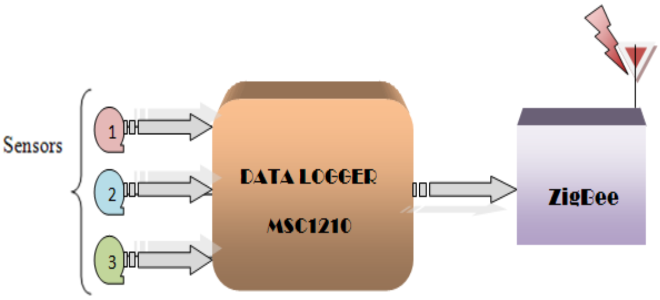

Fig. 7 Sensor Node

This MSC1210 is used as a data logger for the logging of data. It consists of 8051 microcontroller, Analog to digital converter, on chip temperature sensor to measure chip temperature and a flash memory to store the received data. The MSC1210Yx is a completely integrated family of mixed-signal devices incorporating a high-resolution delta-sigma ADC, 8-channel multiplexer, burnout current sources, selectable buffered input, offset DAC (digital-to-analog converter), PGA (programmable gain amplifier), temperature sensor, voltage reference, 8-bit microcontroller, Flash Program Memory, Flash Data Memory, and Data SRAM. On-chip peripherals include an additional 32-bit accumulator, an SPI-compatible serial port, dual USARTs, multiple digital input/output ports, watchdog timer, low-voltage detect, on-chip power-on reset, 16-bit PWM, and system timers, brownout reset, any three timer/counters. The device accepts low-level differential or single-ended signals directly from a transducer. The ADC provides 24 bits of resolution and 24 bits of no-missing-code performance using a Sinc3 filter with a programmable sample rate. The ADC also has a selectable filter that allows for high-resolution single-cycle conversion. The microcontroller core is 8051 instruction set compatible. The microcontroller core is an optimized 8051 core that executes up to three times faster than the standard 8051 core, given the same clock source. That makes it possible to run the device at a lower external clock frequency and achieve the same performance at lower power than the standard 8051 core. The MSC1210Yx allows the user to uniquely configure the Flash and SRAM memory maps to meet the needs of their application. The Flash is programmable down to 2.7V using both serial and parallel programming methods. The Flash endurance is 1 million Erase/Write cycles. In addition, 1280 bytes of RAM are incorporated on-chip. The part has separate analog and digital supplies, which can be independently powered from 2.7V to +5.25V. At +3V operation, the power dissipation for the part is typically less than 4mW. The MSC1210Yx is packaged in a TQFP-64 package.

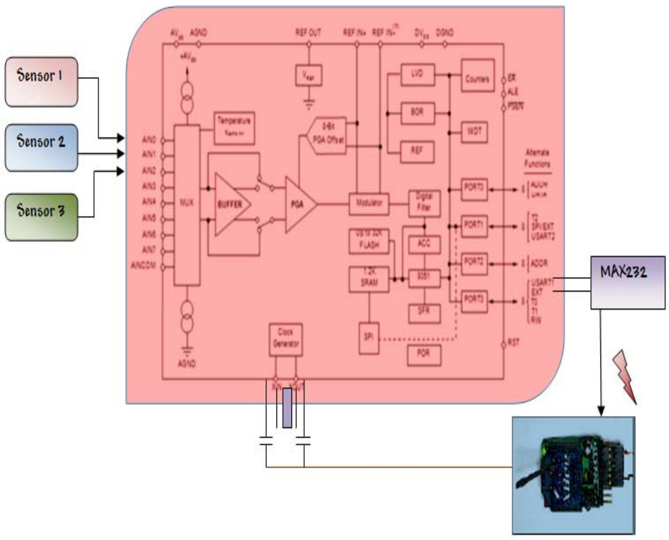

Fig. 8 Schematics Of Circuit Of Wireless Sensor Node

E. ZigBee Module

We proposed the wireless sensor architecture with ZigBee as the mode of wireless data transmission. This transmission mode has been selected after thorough study of the features of mainly three kinds of wireless transmission techniques, ZigBee, Bluetooth and Wi-Fi. Some of the differences have been listed below.

PARAMETERS	ZIGBEE	WI-FI	BLUETOOTH
Range	10-100 meters	50-100 meters	10 – 100 meters
Networking Topology	Ad-hoc, peer to peer, star, or mesh	Point to hub	Ad-hoc, very small networks
Operating Frequency	868 MHz (Europe) 900-928 MHz (NA), 2.4 GHz (worldwide)	2.4 and 5 GHz	2.4 GHz
Complexity (Device and application impact)	Low	High	High
Power Consumption (Battery option and life)	Very low (low power is a design goal)	High	Medium

Security	128 AES plus Application layer security		64 and 128 bit encryption
Typical Applications	Industrial control and monitoring, sensor networks, building automation, home control and automation, toys, games	Wireless LAN connectivity, broadband Internet access	Wireless connectivity between devices such as phones, PDA, laptops, headsets

TABLE IV

DIFFERENCES BETWEEN ZIGBEE, BLUETOOTH AND WI-FI

The ZigBee standard is built on top of the IEEE 802.15.4 standard. The IEEE 802.15.4 standard defines the physical and MAC(Medium Access Control) layers for low-rate wireless personal area networks. The physical layer supports three frequency bands with different gross data rates: 2,450 MHz (250 kbs-1), 915 MHz (40 kbs-1) and 868 MHz (20 kbs-1).

Fig. 9 RF Module – The ZigBee pro

It also supports functionalities for channel selection, link quality estimation, energy measurement and clear channel assessment. ZigBee standardizes both the network and the application layer. This technology offers long battery life, reliability, automatic or semiautomatic installation, the ability to easily add or remove network nodes, signals that can pass through walls and ceilings and a low system cost. Comparing ZigBee and Bluetooth, for applications where higher data rates are important, Bluetooth clearly has the advantage since it can support a wider range of traffic types than ZigBee. However, the power consumption in a sensor network is of primary importance and it should be extremely low, Bluetooth is probably the closest peer to WSNs, but its power consumption has been of secondary importance in its design. Bluetooth is therefore not suitable for applications that require ultra-low power consumption; turning on and off consumes a great deal of energy. In contrast, the ZigBee protocol places primary importance on power management; it was developed for low power consumption and years of battery life. Bluetooth devices have lower battery life compared to ZigBee, as a result of the processing and protocol management overhead which is required for ad hoc networking. Also, ZigBee provides higher network flexibility than Bluetooth, allowing different topologies. ZigBee allows a larger number of nodes – more than 65,000 Sensors. Thus, the suitability of ZigBee for monitoring in agriculture has been proposed here. ZigBee network scalability and reliability is achieved through mesh networking. Networks can scale to hundreds and thousands of devices and all will communicate using the best available path for reliable message delivery. If one path stops working, a new path is automatically discovered and used without stopping the system operation. This long-term reliability is critical for many building automation systems that are expected to last 20–30 years once installed.

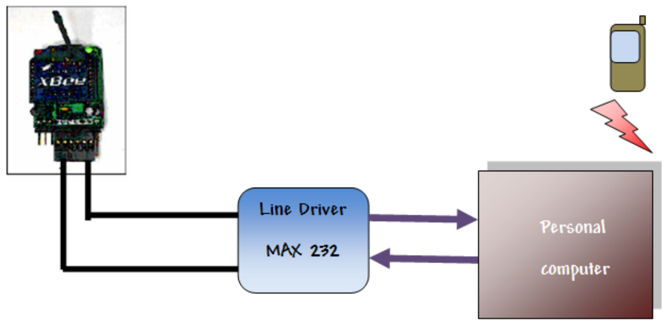

Fig. 10 Establishment of communication through ZigBee

The architecture of the Zigbee module is presented in the below figure. Data enters the module UART through the DIN (pin 3) as an asynchronous serial signal. The signal should idle high when no data is being transmitted. Each data byte consists of a start bit (low), 8 data bits (least significant bit first) and a stop bit (high). The figure illustrates the serial bit pattern a frame of data passing through the module.

Fig. 11 Architecture of Zigbee Pro module

The module UART performs tasks, such as timing and parity checking, that are needed for data communications. Serial communications depend on the two UARTs to be configured with compatible settings (baud rate, parity, start bits, stop bits, data bits).

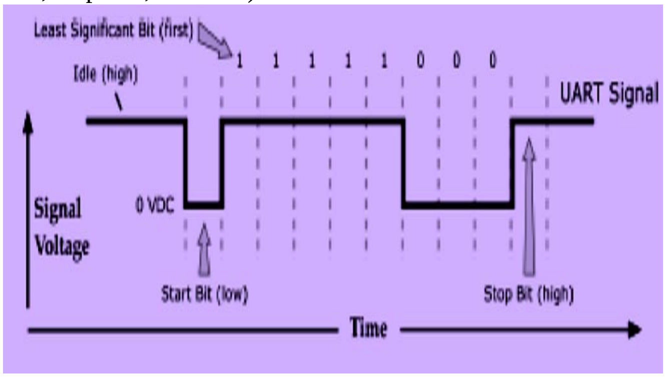

Fig. 12 UART data packet 0x1F as transmitted through the RF module

Thus by this embedded system, Wireless Sensor Node, the humidity dependant signal is produced and transmitted towards the receiver installed at the base station. Now from this base station the recorded information is processed, and can be sent to the farmers via SMS(Short Message Service) as alerts, using a GSM (Global Systems for Mobile communications).

F. Power Management System

Power management is the basic necessity to develop a smart sensor system which uses power efficiently. The system architecture, inserting the contribution of power management system that will utilizes two batteries for night and day time operation. The power management system will manage solar power direction for charging the secondary battery while the primary battery will remain works until at certain level of voltage drops, it will triggered alternate charging-working process for these two batteries.

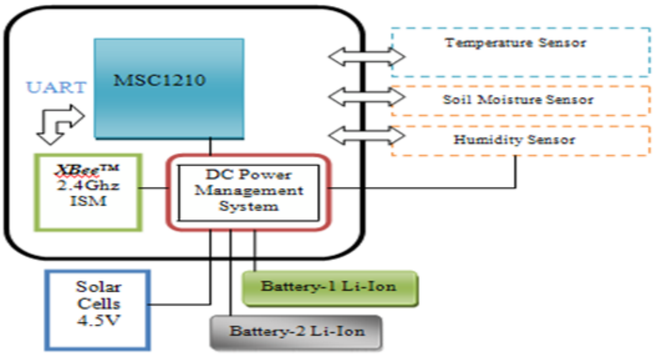

Fig. 13 Sensor node architecture system that features optimal power management system

This method of power management system to be claimed a better power life for nodes up to 25% due to the improved charging concept. Sharing the solar energy for charging a battery while at the same time drawing current from the same battery will loss much efficiency of the battery life, insufficient charging and lead to hassle at night operation or dim daylight. The charging engine for lithium-ion 3.7V cell is driven by MCP73832 charge-pump chip with programmable charging current at 15mA-500mA. The power supply of the sensor node also will apply the low-drop out (LDO) regulator instead of linear regulator that slash a lot of voltage drops and higher noise for switching regulator. The proposed system has the capability to attach more sensors such as the wind speed, dissolved oxygen, water pH, solar radiation to the data logger. The algorithm sequence for working-charging batteries in the nodes power management system is also shown below. The proposed power management system consists of dual Li-ion/Li-Po batteries that will support the nodes life 24 hours a day operation.

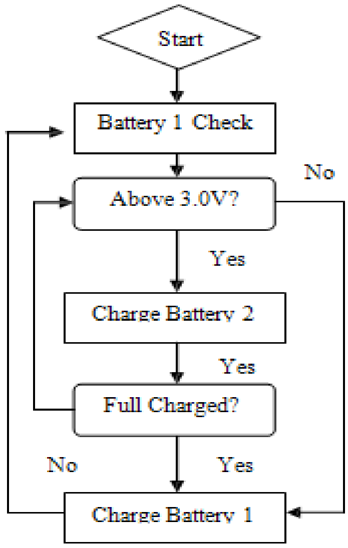

Fig. 14 Battery management algorithm

This architecture will provide better hassle free nodes operation that utilize solar source via separate battery system when charging and consuming at a time.

The proposed project will not attempt too much exhausting the power consumption causes by mesh networking, standard XBee™ module transmit mode or other WSN protocol but optimizing the DC supply and power management system. The nominal current consumption for each node circuit board is about 100-150mA at 4.7V with wireless networking operation. At a starting operation, the Bank 1 battery will discharge the supply to the node while the bank 2 battery will charged by solar source charger.

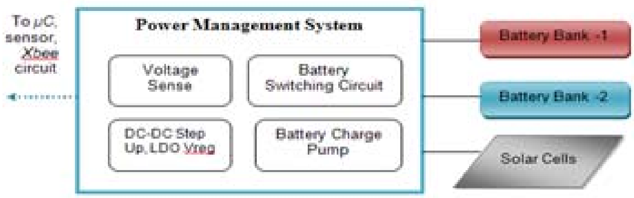

Fig. 16 WSN Platform Power Management System

The systems will automatically alternates the Bank 2 becomes discharged after the Bank 1 drops below 3.7V for each cell and at the mean time it will charge Bank 1. Two banks system will provide maximum slow-charging to the battery by solar cell at 4.5V @ 1 Watt (220mA) to the charge pump drive while the other one discharging current to node. Simple it can be said that first battery will serve while the second will charged by solar cell and stand-by.

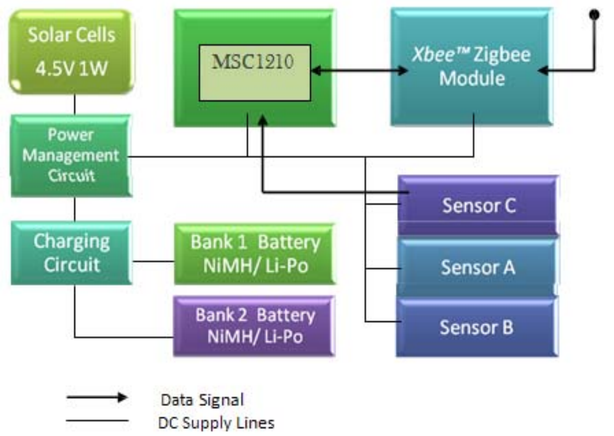

Fig. 15 Architecture of Battery Management Algorithm

Due to low current consumption of the circuit, each battery expected to run up to 8-12 hours operation with 1000 mAh capability. This concept will gives optimum node lifetime especially during night operation while slower and variation of charging rates by solar cells, different or dimmed sunlight intensity and also node operation will not interrupted. The sunlight intensity variations absorbed by solar cell will also disrupting the output voltage. So, that battery will not efficiently or properly charged at day time because of disruption and power loss during node operation and at night time the node may 'dead'. The higher voltage sensor (10-12V) will use DC-DC switch mode power regulator to ensure the supply batteries can manage the sensor operation in the node.

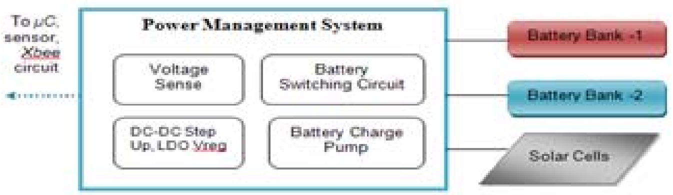

Fig. 16 WSN Platform Power Management System

III. BIO-SENSORS

The sensors hitherto discussed are on-field sensors, which can be employed in the fields for information acquisition. Now these Bio-sensors that we are discussing here are off field sensors which detect the content of pesticides and fertilizers in a given sample of soil. This can help the prevention of environmental pollution, inhibiting the excess use of fertilizers and pesticides. The different pesticides used in food production can accumulate in the fatty tissue of animals, while the excessive use of fertilizers contaminates ground water with nitrates, nitrites and phosphates.

For the detection of herbicides such as phenyl urea and triazines, which inhibit photosynthesis, biosensors have been designed with membrane receptors of thylakoid and chloroplasts, photo-systems and reaction centers or complete cells such unicellular alga and fenilureas and triazines, for which mainly amperometric and optical transductors have been employed. Below are some of the Bio sensors for the detection of pesticides, fertilizers illustrated with the type of interaction involved between the recognition bio-catalyzers and their respective transduction systems for the detection of a particular analyte in the sample.

Analyte	Type of interaction	Recognition biocatalyzer	Transduction system	References
Pesticides				
Parathion	Biocatalytic	Parathion hydrolase	Amperometric	Velasco-Garcia y Mottram, 2003; Parellada *et al.*, 1998
Propoxur and carbaryl	Biocatalytic	Acetyl cholinesterase	Fiber optic	Nunes *et al.*, 1998; Xavier *et al.*, 2000
Diazinon and dichlorvos	Biocatalytic	Tyrosinase	Amperometric	Pérez Pita *et al.*, 1997; Mello y Kubota, 2002
Paraoxon	Biocatalytic	Alkaline phosphatase	Optical	Cosnier *et al.*, 1998; Mello and Kubota, 2002; Patel, 2002
Fertilizers				
Nitrate	Biocatalytic	Nitrate reductase	Amperometric	Moretto *et al.*, 1998
Nitrite	Biocatalytic	Nitrite reductase	Optical	Moretto *et al.*, 1998
Phosphate	Biocatalytic	Polyphenol oxidase and alkaline phosphatase, phosphorylase A, phosphoglucomutase and glucose-6-phosphate dehydrogenase	Amperometric	Cosnier *et al.*, 1998
Heavy metals				
Copper and mercury	Biocatalytic	*Spirulina subsalsa*	Amperometric	Tsai, 2003; Velasco-Garcia and Mottram, 2003
Copper	Biocatalytic	Recombinant *Saccharomyces cerevisiae*	Amperometric	Tsai, 2003; Velasco-Garcia and Mottram, 2003
Cadmium and lead	Biocatalytic	*Staphylococcus aureus* or Recombinant *Bacillus subtilis*	Optical	Tsai, 2003; Velasco-Garcia and Mottram, 2003
Arsenic, cadmium and bismuth	Biocatalytic	Cholinesterase	Electrochemical	Tsai, 2003; Velasco-Garcia and Mottram, 2003
Cadmium, copper, chrome, nickel, zinc	Biocatalytic	Ureasa	Optical	Tsai, 2003; Velasco-Garcia and Mottram, 2003
Copper and mercury	Biocatalytic	Glucose oxidase	Amperometric	Tsai, 2003; Velasco-Garcia and Mottram, 2003

Fig. 17 Most important biosensors used in the detection of pesticides, fertilizers and other pollutants

IV. CONCLUSIONS

In this paper, we proposed a preliminary design on the real-deployment of WSN for paddy cropping, Banana and Turmeric fields in our nearby localities. The system focused on low power consumption for the new design architecture to cater the most important and critical issue nowadays in WSN monitoring. From the sensor node hardware to the management system, the whole system architecture is explained. Such a system can be easily installed and maintained. The scope for future work in this study will include fabrication, experimental investigation, data analysis, control solution and complex networks setups.

REFERENCES

[1] Design and Implementation of sensor node for wireless sensors network to monitor humidity of high-tech polyhouse environment by B. P. Ladgaonkar and A. M. Pawar

[2] MSC1210 - Precision Analog-to-Digital Converter (ADC) with 8051 Microcontroller and Flash Memory - Texas Instruments

[3] www.vegenotrix.com

[4] Preliminary Design on the Development of Wireless Sensor Network for Paddy Rice Cropping Monitoring Application in Malaysia by Muhamad Azman Miskam, Azwan bin Nasirudin from European Journal of Scientific Research

[5] Use of Enzymatic Biosensors as Quality Indices: A Synopsis of Present and Future Trends in The Food Industry from Chilean Journal of Agricultural Research 69(2):270-280 (April-June 2009)

[6] Intelligent Humidity Sensor for wireless sensor network agricultural application from International journal of wireless and mobile networks

[7] An energy efficient wireless sensor network used for farm land and soil moisture monitoring by Zhang

[8] Remote monitoring in Agricultural Green House Using Wireless Sensor and short message service from International journal of Engineering and Technology

[9] www.decagon.com

[10] A review of wireless sensor technologies and applications in agriculture and food industry: state of the art and current trends by Luis Ruiz-Garcia

[11] Agro-sense: precision Agriculture using sensor based wireless mesh networks from IITM, Kolkata, India