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Prescision farming using Nano based wireless sensor network

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***Abstract*—** The main aim of this paper is to propose a state of art nano wireless sensor technology in agriculture, which can replace some of the traditional techniques to the rural farming community. Nano sensors with their small form factor and reliability, these sensors display accurate multisensory capabilities to detect and collect environment data. Nano Sensors comprises temperature, micro temperature, humidity, electrical conductivity, moisture and pH with more in under development (integrated temperature and pH; integrated temperature, nitrate (N), phosphate (P) and potassium (K)). This paper suggests techniques for the corporations to improve on agriculture or farm produce without having to spend excessive time in fields or farms and have a concrete way to improve output. The value of soil ph sensor is sent to the base station and in turn base station intimates the farmer about the soil pH via SMS using GSM modem. obtaining the soil pH value in his mobile the farmer selects the necessary fertilizer and crop for his next season. Hereby the amount of fertilizer can be reduced. The information and technical support will be provided from the crop monitoring system using Nano WSN(wireless sensor network).The automated control of water sprinkling and ultimate supply of information to farmers is done as a result of this project using wireless sensor network.

Keywords—*Nano sensors ; sensing unit ; actuation unit ; power unit ; communication unit ; processing unit ; pams(precision agriculture management system)*

INTRODUCTION :

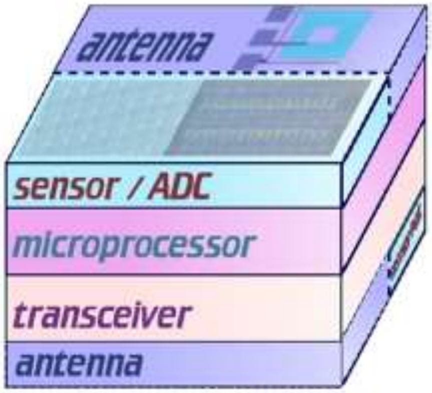
India being an agricultural country needs some innovation in the field of agriculture. This can be achieved through modern technologies which assist computing ,communication and control within the devices. Increasing the yield output by decreasing the input (such as herbicides ,fertilizer and pesticides) called precision or accurate farming has always remained a desired target of the agriculturists. Sensors and satellite systems are used to measure the crops growth at maximum efficiency with the accurate identification of issues and problems.by the controlled farming, pollution will be indirectly minimized by the decreased agricultural wastes. Monitory systems and small sensors prepared by the nanotechnology will greatly affect the near future precision farming practices.

The Nano electronics has the potential to improve the quality, safety and availability of the food that we eat. Nano sensors, similar to those developed for healthcare applications ,that can respond to specific genes or proteins will enable the development of plant strains that are resistant to disease and adverse climatic conditions .Embedded into acting and labeling, nanosensors will provide consumers with an immediate indication of a food's sustainability for human consumption. Embedded into production processes they will ensure the quality, reliability and traceability of food processing operation.

Opportunities also exist in the agrochemical industry .for example, nanoelectronics will allow detection of the presence and degree of biodegradation of pesticides, herbicides and fertilizers, so that they do ot enter the food chain or adversely affect biodiversity or the environment. Developing and implementing such aplications will involve the design and fabrication of biologically sensitive nanosensors for the detection of specific chemical/biochemical signals, and micro-/nano- electromechanical actuators that can respond to those signals.For the communication purpose, a nano sensor is assumed with units for Sensing, Actuation, Power, Processing, Storage, and Communication.

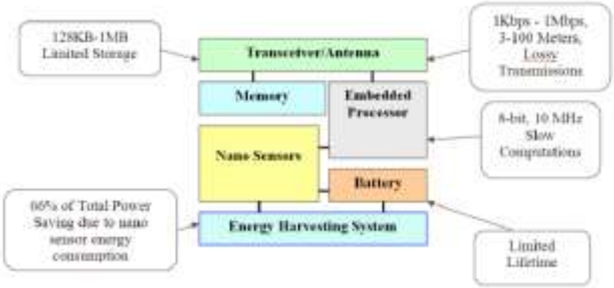
1. Nano sensors

Crop growth and field conditions like moisture level, soil fertility, temperature, crop nutrient status, insects, plant diseases, weeds, etc. can be monitored through advancement in nanotechnology. Such real-time monitoring is done by employing networks of wireless Nano-sensors across the cultivated fields, providing essential data for agronomic processes like optimal time of planting and harvesting of the crops. It is also helpful for monitoring the time and amount of water application, fertilizers, pesticides, herbicides and other treatments. This has moved precision agriculture to a much higher level of control, for instance, in water usage, leading eventually to conservation of water. More precise water delivery systems are likely to be developed in the near future. The factors critical for such development include water storage, *in situ* water holding capacity, water distribution near roots, water absorption efficiency of plants, encapsulated water released on demand, and interaction with field intelligence through nano-sensor systems.



Smart Nano Sensor Node

The above figure illustrates the structure of a single sensor node containing one or more MEMS/optical nano--sensors, an analog to digital interface, a processor for interpreting the nano--sensor data and controlling the network, and then a transceiver to share and receive the nano--sensor information with the outside world. The illustrated figure of the ad-hoc is based on nano--sensor network.

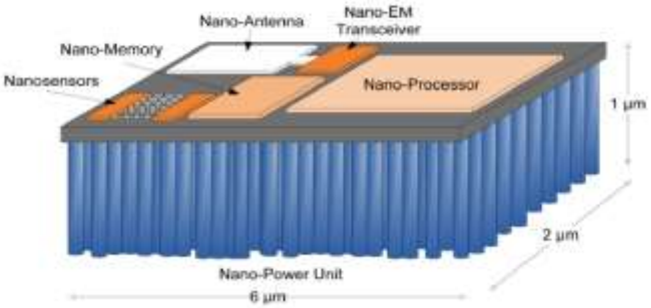


Due to small energy consumption by the nano sensors, processor, antenna and memory, the duration of battery embedded to the nano sensor mote is much longer than normal sensor node which used to be deployed to the body of plant. For the small size of sensor node the possibility of damaging of mote is reduced sharply.

2. The Nano-sensor Techniques and details

The electrolyte channel length is 70 um and electrode gap is 3 um, respectively. The potential responses of cathode during electro deposition of a (led) Pd wire at –1000 nA applied current does not require any electrolyte channel. Initially the cathode potential approaches a negative value, and then it gradually increases at the potential level of led wire growing from cathode to anode. When the wire is fully grown and contact to the anode, the potential drops to zero and it's turned off. The 7 um long led wires were grown at –1000 nA within 1500 seconds. The changes in electrical resistance between gold electrodes during led wire growth at –1000 nA.

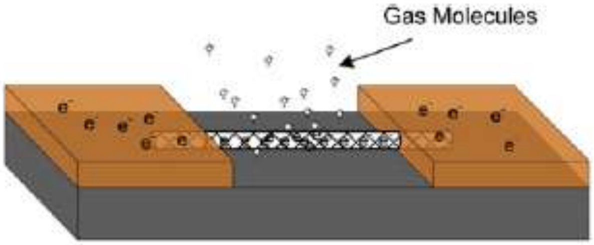
The electrical resistance gradually decreases as the led wire reduces the gap between cathodes to anode. When the led wire contacts the anode the measured resistance is less than 100 Ohm in the liquid electrolyte. The Optical images of the nano sensor containing the electrochemical led wires between gold electrodes are shown in Figure below:



By applying silicon nano-wires gowned chemically as an etch masks, the nano-walls into thin films of silicon is stenciled through electronic transport effects. This similar lithographic

method can also be applied to create any patterned nano-structures of other materials besides Si like graphine. Under certain conditions, a periodical process nano-wire deployment can be obtained by producing a group of nano-wires stacked vertically from a single nano-wire mask. Together, these techniques highlight the potential of this nano sensing process through next generation nano--electronics, sensing, and electromechanical systems.

A. SENSING UNIT



Chemical nanosensors are used to measure magnitudes such as the concentration of a given gas, the presence of a specific type of molecules, or the molecular composition of a substance. The functioning of the most common type of chemical nanosensors is based on the fact that the electronic properties of CNTs and GNRs change when different types of

Molecules are adsorbed on top of them, which locally increase or decrease the number of electrons able to move through the carbon lattice. Similarly to physical sensors, when a nanotube or a nanoribbon is used in a transistor configuration, the presence of a specific type of molecules changes the on/off

Threshold voltage of the transistor. For the time being, hundreds of chemical nanosensors based on this simple principle have been manufactured with different specific detection targets

B. Actuation unit

An actuation unit will allow nanosensors to interact with their close environment. Several nano actuators have also been designed and implemented so far. Chemical and biological nanoactuators are mainly based on the interaction between nanomaterials and nanoparticles, electromagnetic fields and heat. Magnetic nanoparticles and gold nanoshells can also be used for targeted drug delivery, in which the drug containers are melted by applying local heat. For the time being, these nanoparticles are irradiated using external light sources. By using nanosensors and nanoactuators, they could be locally irradiated, requiring much less power and enabling less invasive treatments. The area of nanoactuators is at a very early stage when compared to nanosensors. The main research challenge, besides the design and fabrication of the actuation unit, is on how to precisely control and drive the nanoactuator. The majority of potential applications of these nanosensors will be in the biomedical field, therefore, the accuracy is one of the fundamental requirements for nanoactuators.

Power unit

To date, a major effort has been undertaken to reduce existing power sources to the microscale and the nanoscale. Nanomaterials can be used to manufacture nanobatteries with high power density, reasonable lifetime and contained charge/discharge rates. For example, in lithium nanobatteries were constructed using alumina membranes having pores 200 nm in diameter. Each one of these pores was filled with PEO_lithium triflate electrolyte and capped with a cathode material, becoming an effective nanobattery. The measured volumetric capacity for each individual nanobattery was in the order of 45 mAh,1 cm,2mm proving their potential for powering nano-devices. However, having to periodically recharge them limits the usefulness of nanobatteries in realistic nanosensors applications. In order to overcome the limitations of nanobatteries, the concept of self-powered nano-devices has been recently introduced in. The working principle of these devices is based on the conversion of the following types of energy into electrical energy:

Mechanical energy: produced for example by the human

body movements, or muscle stretching.

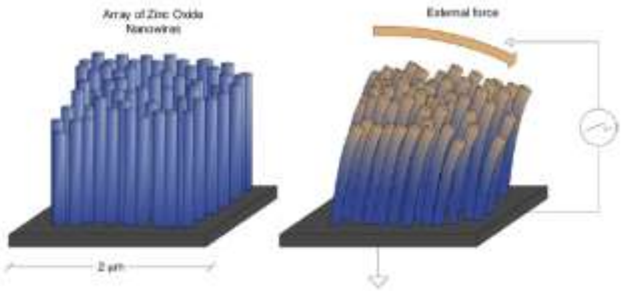
Vibrational energy: generated by acoustic waves or structural vibrations of buildings, amongst others.

Hydraulic energy: produced by body fluids, or the blood

flow.

This conversion is obtained by means of the piezoelectric effect seen in zinc oxide (ZnO) nanowires. Simply stated, when these nanowires are subject to mechanical deformation,

such as when they are bent, a voltage appears in the nanowires . In addition, nanotubes and nano cantilevers can be designed to absorb vibrational energy at specific frequencies . Moreover, it has been recently demonstrated that a nonlinear oscillator can be used to harvest energy from wide spectrum vibrations or even mechanical and thermal noise . The resulting energy can be directly used by the device or used to charge a nanobattery.



Our vision is that harvesting energy from the environment is the most useful solution for powering nanosensors. In addition to mechanical, vibrational or hydraulic energy, we believe that it will be possible to harvest energy from electromagnetic waves in the nanoscale. For example, a resonator based on a NEMS can be used to convert EM radiation into vibrational energy, and this can be converted into electricity by means of ZnO nanowires. Alternatively, nanoscale rectennas, i.e., rectifying antennas that convert electromagnetic waves into DC electricity, could be developed using CNTs. In addition, the use of CNTs to develop solar nano-cells is also suggested in . Another option would be to develop synthetic chemical batteries based on ATP or adenosine triphosphate, the energy source of cells and living organisms , which could be harvested from the medium or even obtained by chemical reactions in the nano scale emulating cell respiration. Independently of the solution adopted, there will be a strong compromise between the power unit size, the total energy harvested and stored, and the capabilities of an integrated nanosensor device, and this should be taken into account in almost every detail of WNSNs design.

Processing unit

Nanoscale processors are being enabled by the development of tinier FET transistors in different forms. Nanomaterials, such as CNTs and specially GNRs, can be used to build transistors in the nanometer scale. For instance, the smallest transistor that has been experimentally developed up to date is based on a thin graphene nanoribbon, made of just 10 by 1 carbon atoms, i.e., less than 1 nm in all its dimensions. Graphene-based transistors are not only smaller, but predictably faster. Graphene shows almost ballistic transport of electrons. As a result, electrons can travel larger distances without being back-scattered and this allows for the development of faster switching devices. In addition, the reduction of the channel length also contributes to a faster response of the transistor. The theoretical predictions for the switching frequencies of graphene-based transistors are in the order of up to a few hundreds of terahertz , which is faster than any existing silicon FET transistor for the time being. The small size of nanosensor devices will limit the number of transistors in nanoscale processors, limiting the complexity of the operations that these will be able to do, but not the speed at which nano-processors will be able to operate. As an alternative to graphene, in , a transistor is developed whose active channel is composed of a single phosphorous atom in silicon. In this case, electrons were able to tunnel through the phosphorous atom or not depending on the voltage applied to a nearby metal electrode with a width of just a few tens of nanometers. While the concept of single atom transistors is apparently proved, it is still too early to think of the specific capabilities that a processor based on this technology and limited in size can achieve. Independently of the specific approach followed to design these nano-transistors, the main challenge is in integrating them in future processor architectures. Experimental testing of individual transistors has been successfully conducted, however, simple processing architectures based on these are still being investigated and, so far, the future processor architectures based on CNTs and graphene still need to be defined.

E. STORAGE UNIT

A Nano-memories utilizing a single atom to store a single bit are being enabled by nanomaterials and new manufacturing processes. Back in 1959, Richard Feynman introduced the concept of atomic memory, i.e., the possibility to store a bit of information in every single atom of a material. In the example he used, Feynman suggested a basic memory unit composed of 5 by 5 by 5 atoms, i.e., 125 atoms in total. He proposed this structure instead of using a single atom in order to prevent potential interference between adjacently stored bits. The resulting 125 atoms for a bit are comparable to the 32 atoms that store one bit of information in DNA. In terms of density, if this were realized with a carbon structure, in which the separation between two atoms is in the order of 0.142 nm , the equivalent storage density would be more than 1 bit=nm3 or 1 gigabit=mm3. While this is still a limit to reach, for the time being several types of atomic memories have been proposed. In , a memory that stores a bit by the presence or absence of one silicon atom was developed. Similarly to the tracks in a CD-ROM, the proposed memory was based on a silicon surface with deposited monolayers of gold defining the tracks . The writing process was performed by means of removing silicon atoms from the gold lattice. Reading the memory was performed by means of a nanotip able to detect the presence or the absence of silicon atoms. This type of memory is not rewritable, but ways to restore the gold tracks and reset the memory can be envisioned. More recently, IBM Corp. has demonstrated the concept of magnetic atomic memories . In a magnetic memory, single magnetic atoms are placed over a surface by means of magnetic forces . Each atom can be used to store a bit, as it was shown in . Similarly to gold-based memories, the density that can be achieved with this technology is several orders of magnitude higher than what can be obtained through classical mechanisms. While this technology is still behind the type of memories required in programmable nanosensor devices, it is a major step towards the realization of this paradigm. Several research challenges for nano-memories are summarized in what follows. First, for the time being, existing nanoscale memories require complex and expensive machinery to be written. Being able to read and write these memories in the nanoscale will be necessary for programmable nanosensor devices. Second, similarly to nano-processors, one of the main challenges is to mass manufacture compact nano-memories beyond simplified laboratory prototypes.

F. Communication unit

The Electromagnetic communication among nanosensors will be enabled by the development of nano-antennas and the corresponding electromagnetic transceiver. In the following, we describe the latest implementations for these two elements as well as an alternative based on a mechanical resonator.

a) Nano-antennas:

Reducing the antenna of a classical sensor device down to a few hundreds of nanometers would require the use of extremely high operating frequencies, compromising the feasibility of electromagnetic wireless communication among nanosensor devices. However, the usage of graphene to fabricate nano-antennas can overcome this limitation. Indeed, the wave propagation velocity in CNTs and GNRs can be up to one hundred times below the speed of light in vacuum depending on the structure geometry, temperature and Fermi energy . As a result, the resonant frequency of nano-antennas based on graphene can be up to two orders of magnitude below that of nanoantennas built with non-carbon materials. A few initial antenna designs based on grapheme have been already proposed. In , the mathematical framework for the analysis of CNTs as potential dipole antennas was developed. In , more emphasis was given to the numerical performance analysis of these antennas when compared to classical dipoles. When it comes to GNRs, the propagation of EM waves on a graphene sheet was first analyzed in . In nano-patch antennas based on GNRs and nano-dipole antennas based on CNTs are quantitatively compared, illustrating that a grapheme nano-antenna 1 mm long can efficiently radiate EM waves in the terahertz band (0.1_10.0 THz). While being the first time that the terahertz radiation properties are pointed out for nanoribbons, the interaction between terahertz waves and carbon nanotubes in reception was previously addressed in . From the optical perspective, the emission of photons from nano-structures due to electron_phonon interaction , i.e., the interaction between electrons and vibrating ions in the material, has motivated the study of CNTs and GNRs as optical emitters and detectors. In , it is mathematically demonstrated that a quasi-metallic carbon nanotube can emit terahertz radiation when a time varying voltage is applied to its ends. Similarly in , the absorption of infrared radiation in a nanotube is experimentally demonstrated. In addition, several ongoing projects are conducting research on optical nano-antennas. An optical nano-antenna is a device which is able to emit energy to the free-space from a confined region with a size in the order of the wavelength of the light . The discovery of nanotubes enabled the development of resonant structures with a size in the order of the light wavelength and triggered the development of this new field. We summarize the research challenges for nanoantennas as follows. First, more accurate models for nanoantennas based on nanotubes and nanoribbons need to be defined by providing details on their specific band of operation, radiation bandwidth and radiation efficiency, amongst others. All these will determine the communication capabilities of nanosensor devices. Second, new nanoantenna designs and radiating nano-structures need to be developed by exploiting the properties of nanomaterials and new manufacturing techniques. Our vision is that it will be possible to create new atomically precise nanoantennas by using graphene, and in which symmetry will play an important role. For example, we can think of fractal nano-antennas able to efficiently resonate at different frequencies within the terahertz band. Last but not least, a new antenna theory must be defined by accounting for the quantum effects observed in the nanoscale.

b) EM nano-transceivers

The EM transceiver of a nanosensor device will embed the necessary circuitry to perform baseband processing, frequency conversion, filtering and power amplification, of the signals that have to be transmitted or that have been received from the free-space through the nano-antenna. Taking into account that the envisioned nano-antennas will resonate at frequencies in the terahertz band, RF FET transistors able to operate at these very high frequencies are necessary.Several graphene-based FET transistors operating in the sub-terahertz and lower part of the terahertz band have been demonstrated so far. IBM Corp. has recently announced the first RF transistor made with graphene which is able to switch at 100 GHz. Their next target is to make a RF transistor operating at 1 THz. In the RF performance of epitaxial graphene FET transistors was measured, showing the potential of graphene transistors for RF applications. In , graphene-based frequency multipliers are implemented with graphene. Fast switching NEMS for RF applications are discussed in by showing that graphene can be used to fabricate oscillators beyond 1 THz. Several research challenges for graphene-based transceivers are summarized in the following. First, it is necessary to characterize and model electronic noise in graphene-based electronics. The electronic noise has a strong impact on the signal to noise ratio at the receiver and, thus, limits the communication range of nano-devices. Graphene shows almost ballistic transport of electrons for large lengths . As a result, the thermal noise created by inelastic scattering of electrons in the material is very low . More accurate models of noise are necessary. Second, new communication and information modulation techniques need to be developed. Our vision is that the EM transceivers of nanosensor devices will be limited in terms of complexity due to space constraints and integration limits, but not limited in terms of switching speed or electronic noise. For this, we think that it is necessary to simplify existing communication techniques and to develop new ways to exploit these two characteristics.

Precision agriculture monitoring system (PAMS)

PAMS allows online 24/7 viewing of field sensor data such as environment data, thresholds, alerts, network health and generate charts and reports of the data. Therefore, real estate monitoring can be done from anywhere in the world at any time. Each sink node placed in various places in the forest is connected to the central server of data storage for further processing through wireless connectivity. When a sink collects data from the sensor field, it first broadcasts a query request within the cluster where it resides. Since the leader of the cluster is always awake, it picks up the query and forwards it toward Sink node in the same way as event information is forwarded. When the query reaches Sink node, the Sink node checks its memory to find if there is a match of event information. If so, it sends the event data back to the sink along the reverse path. If there is no data found, the Sink node broadcasts the query in Sink node in the same way as an event is broadcasted

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CONCLUSION

In this paper, we proposed real-deployment of WSN based crop monitoring which is designed and implemented to realize modern precision agriculture. End Users can tailor the mote operation to a variety of experimental setups, which will allow farmers to reliably collect data from locations previously inaccessible on a micro-measurement scale. Such a system can be easily installed and maintained. This paper successfully applies the wireless sensor networks on agro-ecology fields by investigating environmental situations. The complete real-time and historical environment information is expected to help the agro-ecological specialists achieve efficient management and utilization of agro-ecological resources

REFERENCES:

1. Professor Murthy.S.S.S.chavali yadav,vignan's university,Towards development of wireless sensor system for monitoring anesthetic agents,sensor letters,vol.8,2010
2. Vimal upadhaya dr.sonali agarwal, application of wireless sensors for wild life, international journal of distributed and parellel systems,vol.3,no.4 july 2012
3. Ian f.akyildiz ,josep miquel jornet, Electomagnetic wireless nanosensor networks,school of electrical and comuter engineering,georgia institute of technology
4. Stephen W.searcy,Precision farming:a new aproach to crop management,Texas agriculture extension service,The texas a&m systems.
5. Hafiza tahira gul,shafqat saeed,fawad zafar ahmad khan,syed amir manzoor,Potential of nanotechnolgy in agriculture and crop protection.aplied science and busineess economics,volume 1,issue 2,23-28;2014
6. Supriyo data,professor Purdue university,online classes on "fundamental of nanoelectronics" in edx 2015.
7. N.sakthipriya,An effective method for crop monitoring using wsn, middle east journal for crop managemnt ISSN : 1990-9293