RESEARCH INSIGHTS AND CONSTRAINTS INVOLVED IN ENVIRONMENTAL MONITORING USING WSN

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Abstract

Wireless sensors do cooperative actions because of inadequate possessions like batteries, processors and limited memories. Today, application of WSN is numerous and assorted, and application towards farming are currently promising. One interesting WSN solicitation is in environment observing and greenhouse, somewhere the plant environments like weather and soil shall not be contingent on natural means. For managing and monitoring these environment issues, sensor and actuator is deemed to be critical. In these conditions, WSNs must be employed for making a distributed valuation, dispersion of sensors over the greenhouse using distributed clustering. This paper discloses certain serious matters when wireless sensor networks are uncovered towards real-world atmosphere for monitoring and managing the parameters such as temperature, moisture, smoke, CO_2, light and how distributed grouping contrivances shall be combined inside these monitoring processes.

Keywords: **WSN, atmospheric controller, CO_2 observing and distributed grouping.**

I. INTRODUCTION

Due to current technological advances, the development of materials for tiny and low cost sensors became technically and economically reasonable. In order to put into practice a WSN, few parameters are to be well thought-out: deployment of wireless sensor nodes, uncovering of percentage of pollution (De Boer, 1998) and other environmental conditions, converting them into an equivalent electrical signals for processing. An enormous number of these sensors nodes can be networked in countless applications (Van Egmond, 1998) that entail unattended operations fashion a wireless sensor network. Wireless sensors are devices that vary in size from a portion of glitter to a floor of cards. Integration of a variety of components with an internal distributed clustering mechanism for these sensor nodes craft an exceptional monitoring system. A sensor node is functionally composed of: sensing unit that is intended and programmed to sense pollutants in air, light, temperature, humidity, pressure, etc., a converter that converts the sensed signal from analog to digital signal, a processing unit process the signals sensed form sensor with aid of embedded memory, operating system and few related transceiver circuits. A radio unit facilitates communication from the node level to the sink level. Powering these components is classically one or two tiny sized batteries. There are also wireless sensors exploited in applications that use a fixed assessment, wired power source and do not use batteries as power source. In an exterior environment where the power source is batteries, wireless sensors are positioned in an area of interest that is to be monitored, any in a random or known fashion. The sensors self-organize themselves into a network using any clustering mechanisms, thereby proficiently grouping the sensor nodes to supervise the area for gas measurement, moisture levels in air and transmit the data to a central node called as cluster head

(CH), which in turn periodically onward the aggregated data to the tenuously located base station (BS). The nodes may be the identical as the other detection nodes or because of its augmented requirements or may be a more sophisticated sensor node with bigger power can be used. The most pro of wireless sensors is that they may be implemented in an environment for extended time period, incessantly detecting the environment without the need for human interaction or action. If a centralized clustering method is used, the operation becomes immobile with unchanging design, leading to reduced scalability. When a distributed clustering technique is employed, the CH can be rotated periodically, thereby the life span of the wireless sensor nodes can be prolonged with added scalability. This investigation discusses a quantity of chief issues when a distributed clustering mechanism is used for real world environmental monitoring application.

II. RELATED WORK in ENVIRONMENT MONITORING

Quite a lot of technological solutions based on wireless networks have been planned to monitor fire happenings. A small number of these wireless schemes are realized unaccompanied, but there are few that blend numerous technologies. Furthermore, there are complementary types of technologies such as a GPS system, which can be added to perk up their performance. There is an imperative system for forest fire detection based on satellite imagery, which studies the images taken from satellites. But, weather conditions are greater important problem in these systems. Clouds and rain soak up parts of the frequency spectrum and lessens spectral resolution of satellite imagery. So, the performance of this arrangement changes very much. Satellites can keep an eye on a large area, but the resolution of satellite images are near to the ground. A fire is detected when it has grown-up quite a lot, so real time detection cannot be provided. Moreover, these systems are very costly. The system presents numerous advantages: automatic action, consistent data superiority, cost-effective use and rapid response but not in real-time.

A novel system called Fire sensor sock, to defend every sensor node of a wireless sensor network in order to keep away from these devices being damaged or destroyed when they are sending the data, detecting or controlling a fire has been anticipated. Fire sensor sock is an extraordinary protection dedicated to the thermal insulation of sensors that leave undamaged their ability to sense thermal data. Thus, the purpose of this work is to have a wireless sensor network that is intelligent to resist being burnt. The sensors will keep on transmitting data flow to the final user. Besides, a WSN protected with Fire sensor sock is capable of sensing thermal information in the open air. They are able to spot a fire and track the fire spread during its spatial and temporal evolution.

Nowadays, wireless sensor networks are widely used to watch, detect a fire and there is a fair quantity of literature on it. An example is the Fire Bug system. A system based on a wireless sensor network for forest fire monitoring has been planned with MICA motes using GPS attached to it. Its purpose is to assemble environment parameters like temperature, relative humidity and the barometric pressure whilst there is an active fire. Motes correspond with base station and information is amassed in a database server. Thus to have admittance to this server, a net browser based on a web significance which is able to communicate with the database server is required. This design uses the Crossbow sensor mote and the Tiny OS programmed in the nesC language. This software is solely built up for embedded devices.

The provisions that have to be well thought-out for such sort of network, together with liability of firefighters, smart scheduling and resource allotment, web services and incorporation. To fulfill these requirements, Fire Net has been projected. It is a wireless sensor network structural design where sensors are sprinkled in vehicles, figuring a self-organized heterogeneous network with the fire fighters. Fire Net design is considered to be tremendously supportive for fire rescue process. The Forest Fires Surveillance System (FFSS) was developed after that. If a fire is noticed, FFSS automatically turns on an alarm to assist a hasty extinguishing of the spreading fire. In this piece of work, the nodes employ TinyOS as the operating system. In adding up, the WSN exercise a minimum cost path forwarding (MCF)

to hurl their information to the sink node. One more characteristics analyzed is the quantity of measurements taken from varied sensors to reduce error estimation. A distributed algorithm is in use to resolve this sort of problem.

The purpose of FireWxNet is to decide the behavior of fire rather than its detection. It contains a WSN that functions as a gauge to monitor weather conditions around an active fire. Webcams are employed to acquire visual data of burned area and the base station which is capable of providing lengthy distance communication. For each predetermined time period, the arrangement measures environmental temperature, relative humidity, wind speed and its direction. In contrast, cameras present images constantly regarding the current state of the vigorous fire. The arrangement uses lengthy distance wireless communication links, sensor networks and few web-cameras. The outcome of the arrangement is found to be exceptionally first-class and they reveal that it is exceedingly supportive to investigate the fire behavior.

Military applications are incredibly and intimately related to the perception of the sensor networks (Rajaravivarma et al., 2003). In reality, it is exceptionally rigid to speak for definite whether motes were developed because of military and defense needs or whether they were invented autonomously and were subsequently useful to armed forces. Concerning armed applications, the province of concentration extents from information collection, normally to opponent tracking (Hao et al., 2006) or battleground surveillance. For instance, mines might be regarded as dangerous and obsolete in the future and may be replaced by thousands of separated motes that will sense an intrusion of defensive units.

Outdoor monitoring is another celestial area for applications of wireless sensors networks. one of the fabulous examples is the exploitation of wireless sensor nodes on an Island. This wireless sensor network was used for habitat observation (Dardari et al., 2006). The sensor nodes that were employed were talented to sense and monitor the temperature, barometric pressure and humidity. Additionally, passive infrared sensors and photo resistors were engaged at a moderate level. The traditional arrangement was employed to effectively monitor the natural background of a bird and its behavior according to the changes in relative climatic conditions. For such reason, a quantity of wireless sensor motes were installed inside birds burrows to speck out the bird's presence while the rest were set out in the close by location areas. The data sensed by various motes are aggregated by the utilization of sensor nodes and are conceded to the monitoring station through the gateway.

Management of precious assets like utensils, equipments and diverse types of products can be a quandary. Owing to this reason, the dilemma is highly distributed, as these corporations expand to the edge of the globe. One emerging gifted way to realize the tracking of asset and deal with this problem is believed to be with the use of wireless sensor networks. The appliance of sensor nodes in petroleum bunks and chemical warehouses refers to warehouses and storage management of containers or barrels. The design is that sensor motes attached to large barrels will be intelligent to locate nearby located objects, detecting their content inside and alerting when inaptness happens with their own and aging effects.

Health care system can also yield from the use of wireless sensor nodes with the patients. Emerging applications in this category include telemonitoring human physiological statistics, monitoring of the patients within a hospital, monitoring drug administrator in hospitals, etc (Lee et al., 2006). In case of smart sensors, retina prosthesis chip constituting of hundreds of sensors are set within the human eye. This allows the patients with inadequate vision to see at a relative ample level. Cognitive disorders which might probably lead to Alzheimer's can be monitored and very well controlled at their premature stages with the aid of wireless sensors.

Robotic applications previously implemented are the unearthing of level sets of scalar fields using mobile sensor networks and imitation of the task of bacteria for seeking and discovering dissipative gradient sources. The tracking of a light source is complete with some of the basic algorithms. In addition, a reply to the coverage problem by robots and motes is accomplished for thick measurements over a broad area. The association of both static and mobile networks is accomplished with the aid of mobile robots,

which travel around the environment and arrange motes that act as beacons. The beacons help the robots to portray the directions. The mobile robots can act upon as gateways into wireless sensor networks. Examples of such tasks are: supporting the energy resources of the wireless sensor network indefinitely, configuring the hardware, detecting sensor collapse and apt deployment for connectivity in the midst of nodes.

Landslide discovery employs distributed sensor scheme for predicting the occurrence of the landslides in hilly areas. The idea of predicting the hilly-area landslides by means of wireless sensor networks arose out of a must to alleviate the destruction caused by landslides to individual lives and to the railway networks. A fusion of practices from terrain sciences, signal processing, distributed systems and fault tolerance is employed. A solitary peculiarity of these type of systems is that it joins a quantity of distributed systems techniques and technologies to pact with the complexities of a distributed wireless sensor network environment where connectivity is underprivileged and power budgets are extremely unnatural, while rewarding real world necessities of safety and fortification. Normally these methods make use of a collection of single-axis strain gauges united to contemptible nodes each one with unique processor, battery and exclusive wireless transceiver block.

Forest fires, also recognized as wild fires are wild fires happening in wild areas and cause chief damage to human resources (Cerpa et al., 2001). These forest fires washes out forests and might consequence in soaring human demise toll nearer to urban regions. Some regular causes of forest fires comprise of lightning, human carelessness and seepage of fuel to great heat. It is acknowledged that in a miniature number of cases fires are components of the forest ecosystem and they are remarkable to the life cycle of local habitats (Edoardo Biagioni et al., 2002).

Sensor-Clouds can be used for fitness monitoring by using a quantity of simply obtainable and most frequently wearable sensors like accelerometer and temperature sensors, so forth to fetch together patient's health-related information for tracking sleep action pattern, human body temperature and other respiratory situations. These devices should have the support of a wireless interface for streaming of information and are coupled wirelessly to a smart phone through this interface. These smart devices performs like a gateway between the remotely located server and the wireless sensor network through the internet.

III. PARAMETERS UNDER DISCUSSION

A. The Greenhouse Environment

A recent greenhouse can consist of several parts which include their own local climate settings (Zhang Qian et al., 2007). Hence, quite a group of measurement points are also enviable. This smart environment is necessarily demanding both for the wireless sensor node electronics and for the short-range wireless network in which communication range is to a vast extent longer in wide areas.

B. Sensors

Speedy response time, relative humidity and temperature, the sensor forms an ideal solution for greenhouse environment. Smart communication between the sensors is analogous to IIC interface. Patchy output signal is properly handled by a filter to obtain accurate luminosity values. CO_2 measurement and processing takes quite longer time than other measurements and these sensor voltage supply must be within a fewer voltage levels. The CO_2 estimation can be examined from the corresponding output voltage levels. The operational amplifier raises the voltage level or generally increases the amplitude of the frail signal from the wireless sensor.

C. Greenhouses

A greenhouse is an array covering the ground frequently used for expansion and development of plants that will revisit the owner's assets (Jong-Won Kwon et al., 2009). This arrangement is basically mounted with the belief of defending the crop and allowing an improved environment for its progress. This guard is much adequate to guarantee a superior quality in the production in some cases. But, when the foremost intention is to achieve an improved control on the horticulture expansion, it is indispensable to manage the variables that sway the growth of a

culture. The function of a greenhouse is generally to supply a more auspicious environment than the outside environment. Contrasting to what happens in the traditional agriculture, where crop yield depends on natural world resources such as climate and soil, whereas a greenhouse should promise better production independently of climatic factors. It is very important to examine that even a greenhouse protects crop from exterior factors, it may reasons to several problems such as fungus and extreme humidity conditions. As a result, the mechanisms to detect and control a greenhouse atmosphere are awfully significant for attaining improved productivity. To achieve first-rate productivity, a superior control method is important and thus the production costs also gets abridged. The central elements involved in a greenhouse control system are temperature, humidity, concentration of carbon dioxide, light radiation, water availability and minerals.

D. Temperature

Temperature is one of the most significant factors to be monitored because it is unswervingly related to the plant growth. Intended for all plants, there is a minimum temperature assortment considered to be perfect and to most plants this range is comparatively varying around 30ºC. Amongst these temperature parameters of to be controlled are essential the extreme, maximum, minimum temperature and tolerably the difference between these temperatures.

E. Water and humidity

An additional imperative aspect in greenhouses is water. The assimilation of water by plants is associated with radiation. The nonappearance or low level of water influences growth and photosynthesis. Besides this, air and ground humidity also adjust the development of plants. The air humidity is correlated with transpiration, while the ground humidity is interrelated to water absorption and photosynthesis. An environment with extreme humidity decreases plants transpiration thereby reducing the growth and may endorse the proliferation of fungus. On the other hand, low humidity level environments might cause dehydration of the plants.

F. Radiation

Radiation is an influential element in greenhouse production and sunlight is the most important source of radiation. It is an indispensable constituent to photosynthesis and for carbon fixing. The important radiation features are concentration and duration. The radiation intensity is allied to plant growth and the duration is unswervingly connected to its metabolism.

G. CO_2 concentration

CO_2 is important because it is an indispensable nutrient for plant development, allowing the assimilation of carbon. The carbon retaining process occurs throughout the photosynthesis, when plants take away CO_2 from the environment. Throughout the photosynthesis, the plant uses carbon and radiation to create carbohydrate, whose role is to permit the plant growth. Therefore, an enriched air environment should add to the plant growth, but it is important to note that an unwarranted carbon level may turn the environment poisonous.

H. Sensor node functionality

Design of sensor node consist of four fundamental functionalities a) Signal conditioning: The time gap between quantity of gas concentration deposited on the sensing plates and the time required to clear the gas concentration on the sensing plates. b) Sense the changes in air: Sensors are used to sense the changes in gas concentration of different pollutants such as carbon monoxide, carbon dioxide and sulphur concentration in air. As the output of the sensors are analog, the signal strength and correctness need to assured. c) Signal amplification: The signal detected by the sensors are in need to be amplified and regenerated to boost the accuracy of the systems. d) Signal calibration: ADC provides the mapping between analog input signal to digital signals for processing. The integrated ADC in the microcontroller unit is used to renovate the analog signal to the corresponding digital values.

I. Radio design and number of devices needed

In order to plan the wireless sensor network, the signal loss during its path in a rural or forest environment has to be considered to the highest

degree. The major parameter to be considered here is the coverage. How far the Wireless IP camera and the wireless sensor could be from the access point to accept enough signal power has to be cautiously analyzed before real world implementation.

J. Hardware deployment

A router can be used as the core controller. It is an embedded system that has a wireless IEEE 802.11 b interface, a Fast Ethernet interface in its board and so it meets the requisites. In addition, a router offers internally general purpose input/output (GPIO), UART (JP2) and ETAJ (JP1) ports. A few extensions can be made to the router by using these ports.

K. Wireless IP camera

The wireless cameras chosen transmit MPEG-4 standard video compression, which has superior compression and excellence compared to other standards. It also consumes little bandwidth. MPEG-4 is frequently used in video streaming over IP environments. The video is streamed by means of the HTTP protocol with very good quality results. Chosen cameras must be talented to transmit in both directions.

L. Photovoltaic system

The photovoltaic system is fashioned by a photovoltaic panel, battery, load regulator and an inverter. There are several basic types of photovoltaic panels, all of them employ silicon: mono crystalline cells, polycrystalline cells and amorphous cells. Polycrystalline cells are preferably used because they have superior performance than the amorphous cells and they are cheaper than the mono crystalline cells. There are various types of batteries that can be used in a photovoltaic system like VRLA battery and AGM battery.

M. System design and operation mode

The wireless sensors is usually placed in various critical points with supplementary risk. Both the sensors and cameras are beneath the coverage area of the access points. The mode of operation is as follows. All cameras are recorded with the corresponding coordinates where they have to budge and focus for each sensor placed in their visual coverage. The server has a database with the location of the sensors and the name of the cameras placed in the rural area close to every sensor. When a sensor detects a fire, it sends an alarm unswervingly to the server. This alarm message generally has the name of the wireless sensor. Whenever the server gets this message, it searches in its database the neighboring wireless cameras to that sensor and sends them a message with the name of the sensor that has sent the alarm and the location they must move to in order to look at the image of that zone. Finally, the cameras shift their objective to the coordinates of the sensor and the fire fighter can corroborate if there is a fire occurrence or not.

N. User interface

A web page that shows the video streams received from numerous wireless cameras in real time has to be developed. Images are revealed without jumps and there is no any quality reduction in these images. The iris lens should be kept erratic to attain an enhanced visualization. All the cameras can be accessed separately and their control is independent, so users or the fire fighter gets access to the camera and administer it without any trouble.

IV. CONCLUSION

For a wireless agricultural application to be developed, some technological challenges should be determined. A greenhouse is a controlled environment and does not need a set of climatic parameters to be controlled. The use of WSN technology in hefty scale seems to be something for the near future. In this application, enormous number of climatic parameters can be monitored using the sensor nodes available right now. An imperative advantage of using WSN is that it allows distributed monitoring, which provides an additional and precise control of crop conditions. As a greenhouse is a relatively minute and controlled environment, power utilization of the sensor nodes is an important criterion to be considered. This technology can also be useful in breeding of confined animals in precision zoo, where the sensor nodes should propel information about the fauna. To manage and check the environmental factors the wireless sensors and actuators are indispensable. For a WSN to make distributed measure, dispersal of sensors all over the greenhouse using distributed

clustering has been done. This paper reveals some solemn issues when a wireless sensor network is uncovered to real world environment to check and control parameters like temperature, humidity, smoke, CO_2, light and green house gases and how distributed clustering mechanisms can be integrated within this monitoring procedure.

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