WIRELESS SENSOR NETWORKS IN AGRICULTURE

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***Abstract*: These days The Wireless Sensors Network is generally used to construct decision support systems to overcome several problems in the real-world. A wireless sensor network (WSN) has important applications such as remote environmental monitoring and target tracking. This has been enabled by the availability, particularly in recent years, of sensors that are smaller, cheaper, and intelligent. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network. The design of a Wireless Sensors Network depends significantly on the application, and it must consider factors such as the environment, the application's design objectives, and cost, hardware, and system constraints. This paper presents Wireless Sensors Network as the best way to determine the agricultural problems related to crops detection, crop situation, yield estimation etc. This approach provides real-time information about the lands and crops that will help farmers make right decisions. The software monitors data from the sensors in a feedback loop which activates the control devices based on threshold value. Implementation of Wireless Sensors Network in agriculture will optimize the usage of water fertilizer and also maximized the yield of the crops. The Wireless Sensors Network is an intelligent system which can monitor the agricultural environments of crops and provides service to farmers. The wireless sensor network technique attracts increasing attention in current years. The purpose of such systems is to improve the outputs of crops by means of managing and monitoring the growth period.**

***Keywords*: Agriculture, Crop, Monitoring, Sensors, Soil, Wireless.**

Introduction

The world's population is expected to double by 2050; world food supply is unlikely to double by doubling the area under cultivation or by doubling the availability of water. There are other challenges too, such as decline in the number of farms and a decline in the number of agriculture workforce. Climate change is expected to further aggravate the existing situation. Therefore, for the humanity to survive agriculture has to become smart one way is by integrating Wireless Sensor Networks (WSN) in agriculture.

Wireless sensor networks are being used in a wide variety of critical applications such as military and healthcare applications, agriculture and industrial process monitoring. WSN is an intelligent private network made by a large number of sensor nodes which do specific functions. Wireless transmission allows deploy the sensors at remote, dangerous, and hazardous location. WSN has several advantages including easy installation, cost-effectiveness, small size and low power consumption. In recent years, agriculture faces many challenges, while humanity depends on agriculture and water for survival, so precision agriculture monitoring is critical and the demand for environmental monitoring and remote controlling in agriculture is rapidly growing. However, there have been few researches on the applications of WSN for agriculture.

The rapid development in wireless communication and embedded micro-sensing technologies in recent years has made wireless sensor networks possible. A Wireless Sensor Network (WSN) is a network consisting of a large number of distributed wireless sensor devices. WSNs can be used in various monitoring situation where sensors are usually stationary. WSNs have been employed in both military and civilian applications such as target tracking, habitant monitoring, environmental contaminant detections and precision agriculture.

Communications in WSNs are data-centric and intended to deliver collected data to a central location for storage, mentoring and further data processing. There are resource-constrained in dealing with storage space, processing power for sensor nodes, communication bandwidth, and energy. There are number of challenges in research and real world implementations of WSNs. Sensors are usually powered by batteries which have limited power. Thus, sensor hardware and protocol design to save the limited energy and affordability becomes an important issue. The other issues include improving network's stability and robustness enabling self organizing and recovery capabilities. This gives rise to new challenges in information processing and data management in large-scale sensor networks. In-network data processing techniques, from simple reporting to more complicated collective communications, such as data aggregation, broadcast, multicast and gossip should be developed. On the other hand, data collected by sensors can intrinsically be viewed as signals. By exploiting signal processing techniques, collective communications can be done in more energy efficient ways. Moreover, distributed data management schemes need to be devised when sensed data is collected from different sources at different rates.

Working of Sensor Network Technology

The sensor nodes are planted in the area which is under experiment. They sense the different parameters for which they are meant. These all individual nodes perform the minimal data processing and then send back the data via a base station to a single server where they are processed further. Data is transmitted between the individual nodes via a wireless sensor link. Then between the head nodes and the base station through some other link depending on the technology which suits most. At last there is the Data Access Subsystem in which a web-based interface is used for the display and upload of both raw and processed data. As most of the farmers do not have access to the web, those data are made available at a local village center in the form of graphs and spread-sheets.

Involvement of Sensors in Agriculture

Different sensors are employed for sensing various parameters like soil moisture, water levels, climate change, pest detection, humidity to various other things in the fields. For sensing these parameters, the sensors are deployed in the field. They are spread in such a way that they cover the whole field. Now these sensors can be used in many different ways. The basic technology employed in the sensors is the same. Only the way they are spread out differs. But this different arrangement plays an important role as when used efficiently these sensors save time, save the required power and also may decrease the channel congestion, thus increasing the overall efficiency of the whole network.

Identification of Pest and Disease Infestation

Pest detection and control is at least as old as agriculture because there has always been a need to keep crops free from pests. A number of techniques so far proposed for pest control in agriculture using wireless sensor network. There is a solution for monitoring traps which they used to capture pest by means of image sensors. A low-cost system based on battery powered wireless image sensors, which are able to capture and send images of the trap contents to a remote control station with specific frequency demanded by trapping application. These image sensors accurately monitor pest population with a higher temporal resolution. During this monitoring process no human intervention is demanded. There is a significant reduction in monitoring cost as well. Trap monitoring process which works on unattended mode has some extra benefits like it reduces the monitoring cost: it is programmable and higher temporal resolution of trap monitoring data. In addition, monitoring data can be available in real time through an internet connection. There have been a number of valuable studies to monitor pest insect using latest technologies. However, none of these studies provide a self-sufficient monitoring system based on low cost image sensors covering areas with very low energy utilization. High scalability with low power consumption made it possible to deploy both green houses and larger plantations. It is also used for several kinds of insects instead of some specific insects.

Soil moisture estimation

Estimating soil properties, including soil moisture, is important for many water-budgeting processes, and for meteorological and agricultural applications. Soil-moisture information can also be used as an indicator for the prediction of natural disasters, such as flooding and droughts, and for environment changing, such as dust storms and erosions. The most accurate results are achieved when there is no or low soil cover, especially when the test area is flat. On the basis of the active remote sensing methods, estimating soil moisture on bare soil or soil with less vegetation gives more accurate results, as compared to using the methods on a mixture of land-cover soil. Moreover, the estimation process becomes more challenging when the vegetation cover is dense. From the other side, under similar soil cover conditions, retrieving soil moisture using a combination of both active and passive soil information gives reasonably accurate results.

System in Various Agricultural Environments

A wireless sensor network-based agricultural monitoring system was developed. Soil moisture and air temperature/humidity were monitored by sensor nodes of the WSN. The collected information was transmitted wirelessly to a gateway node which was connected to a computer. Considering variable conditions under different agricultural applications, a series of field experiments was conducted to evaluate the performance of the developed WSN system. The communication distance, energy consumption and data transmission performance of the system were tested under three crop environments: a greenhouse, an open farmland and an orchard. The results demonstrate that the received power attenuated sinusoid ally with the increasing distance between a transmitter and a receiver. Reliable signal transmission could be achieved under different environments and at different testing distances. Because the sensor nodes in the greenhouse were closer to the gateway node and the signals in the greenhouse were more prone to be affected by phenomena such as reflection, diffraction and refraction, the RF signals attenuated more slowly and the packet loss rate was lower. In the open farmland and the orchard, as a result of the sparse winter foliage, the shielding effect of the crops was weaker. Thus, the further the transmission distance, the larger the RF signal's attenuation. Packet loss was more likely to occur if the sensor nodes were far from the gateway node.

Conclusion

The wireless sensors networks helps in agricultural monitoring at remote sites and reachable locations. It increases the crop yield and improvement in the quality in the agricultural field by supporting the decision making of producers through the analysis of the collected information. Various methods are used to identify the problematic soil which prevents the farmers from loss of

money and time. Monitoring of draughts and proper irrigation time help the farmers for better yield of the crop. A WSN system capable of monitoring and processing data from number of sensor nodes located in vineyards in three continents. The paper investigated the recent advances in remote wireless sensor devices, and how WSN of these devices could be combined with the internet and used in on-farm operations, such as management decision making, by monitoring weather, atmospheric, environmental conditions and plant physiology, and also for online display of climate information at larger scales. It is also possible that using the data collected with such WSN and from an example proposed herein relating to complicated natural processes could be modelled to gain more insights into these processes, such as the effects of climate change on grapevine and wine quality.

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