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Monitoring Agricultural Crops through Wireless Sensor Networks

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Abstract:- *In recent years, agriculture in India is facing numerous challenges due to fast growth of population in urban areas. Research in wireless sensor networks leads to its application in various agricultural activities such as irrigation management, water management, vineyard monitoring, precision farming etc. A novel wireless sensor network architecture is proposed in this paper for most of the crops in Indian environment in order to achieve less water consumption and more productivity. Densely populated sensors with low power are suitable for short term crops and thinly populated sensors with high power are suitable for long term crops.*
Keywords *–Agricultural crops, nodes sensors, wireless sensor network*

I. Introduction

In India, agriculture has undergone many drastic changes and achieved numerous milestones. Some developed countries are still facing a scarcity in various factors such as agricultural labour etc. Monitoring of agricultural crops is very essential these days. Due to unavailability of human labours, wireless sensor networks (WSN) can be implemented to monitor the crops. Continuous monitoring of the agricultural crops by staffs is inconvenient when the land is situated in the remote area[1]. WSN consists of sensor nodes which collect information and process it. After processing, the information is transferred to base station. The base station sends the received information to the end user through internet.

II. Related Work

Crop monitoring system based on wireless sensor network implements two types of nodes (i.e) scalar sensor node and image sensor node[2] which gathers the temperature, humidity data and crop growth images.

Irregular and inadequate rainfall leads to low yielding of crops. Implementing the soil moisture sensors with proper management zones predicts the suitable amount of irrigation for better yield[3].

Sensor motes are implemented in the rice fields to predict the water level and soil pH sensors intimate about alkaline or acidity for effective use of fertilizers[4].

Growth of sugarcane is based on some climatic factors such as air temperature, humidity, soil temperature and soil moisture. Microcontroller, WSN base station with GSM module, data collecting nodes and some sensor nodes is proposed for sugarcane crop monitoring[5].

Soil moisture sensors can be implemented to decide the time and duration of the irrigation process and scheduling to the agricultural land[6].

In [7], environmental and soil sensors are used to collect the environmental and soil information and CCTVs also implemented to collect image information of the crops.

III. Proposed Work

The main idea behind the monitoring system is to design a wireless sensor network architecture that is suitable for both short term crops and long term crops.

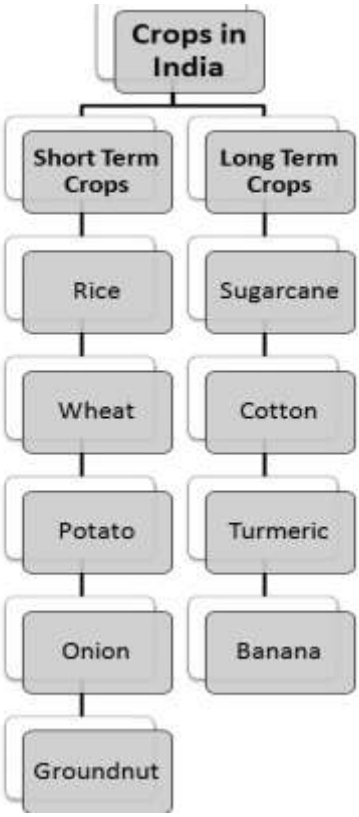

Fig 1: *Classification of crops*

WSN is a layered architecture which consists of five layers. Sensing of information at the agricultural crops is done at the physical layer. The error control and data frame detection is done at the data link layer. The information collected from the sensor node is transferred to the sink node and to the end user through the network layer and transport layer. Processing the information of various crops, aggregating the data and interaction of end user is at the application layer.

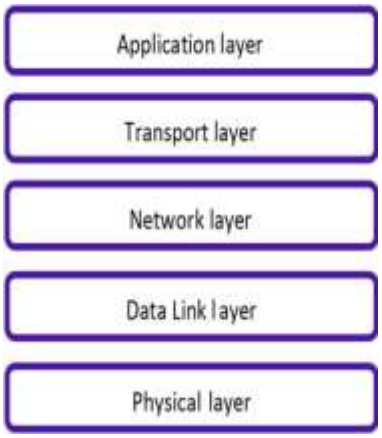

Fig 2: *WSN Layers*

A. WSN FOR SHORT TERM CROPS

WSN consists of battery-powered sensors that are connected through a wireless medium and are implemented for a specific purpose. Low cost sensors are available these days due to advancement in the technology and these sensors collect accurate data in the agricultural crops. Sensors such as pogo portable sensor, hydra probe II soil sensor monitors the soil moisture, water level and soil temperature.

Such type of sensors can be implemented in the short term crop fields with dense population. Low battery-powered sensors can be implemented for short term crops as they are used only for a limited period of time.

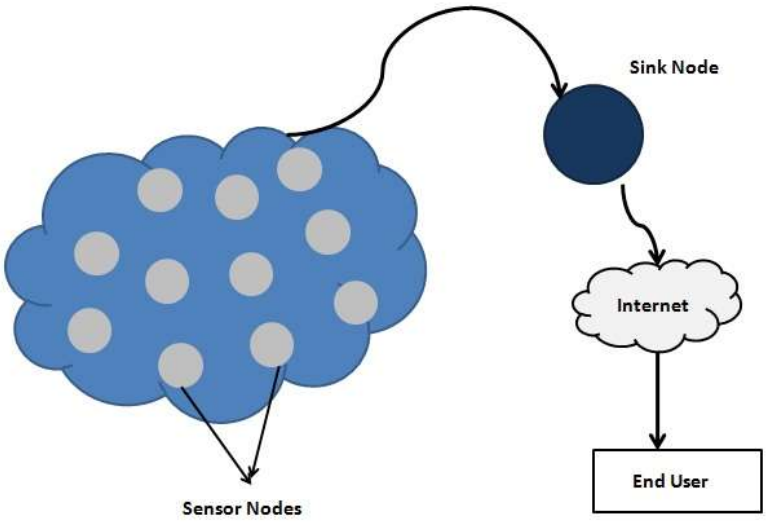

Fig 3: *WSN architecture for short term crop fields*

The above figure depicts a typical wireless sensor network that can be implemented in agricultural applications. Short term crops have higher immediate growth and diseases. So, it does require more number of sensor nodes which frequently collects data and transfer to the end user.

B. WSN FOR LONG TERM CROPS

High power sensors are needed to be implemented for long term crops as their average growth period is between 12-20 months.

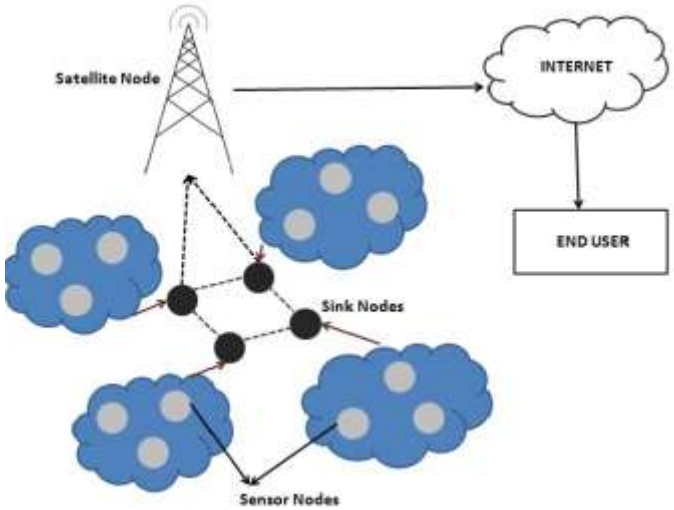

Fig 4: *WSN architecture for long term crop fields*

In the figure, the sensor nodes are thinly populated in the agricultural fields. Each cluster of sensor nodes consists of two or three nodes and they are connected to a separate sink nodes. The sink nodes transfer the collected information to the satellite node. Satellite node which in turn acts as a collection point aggregates the data from sink nodes and sends data towards end user through internet.

IV. Conclusion

The proposed system in this paper is based on the various crops and its requirements in Indian environment. The sensor nodes in the given architecture periodically collects the data and sends to the end user which is useful for the farmers to monitor their crops without going to the field very often. This work structured the monitoring system separately based on the crop growth time. This is a low cost system where only a small number of sensors are deployed for long term crops. Scattering of sensor nodes and clustering into a group saves

energy and reduces the transmission time. This architecture improves the existing monitoring system and helps the farmers to improve crop production.

V. Future Work

Some of the problems still faced by the farmers are sudden attack of unknown diseases and destruction of crops by animals and birds. The future work may include the monitoring of crop diseases by underground sensors and camera sensors.

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