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IoT Based Greenhouse Monitoring using Data Compressive Sensing Protocol in WSN: a review

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ABSTRACT: For proper growth of plants theyneed certain environmental parameters like temperature, humidity and light. Also, Automated Greenhouse Monitoring ignores the need of human operators to take care of the plants. To monitor the Greenhouse parameters like humidity, temperature, soil moisture, a control system based on WSN is needed. An IoT based control system is comprised of greenhouse data acquisition PIC Microcontroller along with temperature, humidity and moisture sensor. In the Wireless sensor network, there may be possibility of failure of nodes because of the power drained or addition of new nodes or may be change in location of nodes due to physical movement, which further results in collision and energy consumption. Compressive sensing (CS) can reduce the number of data transmissions and balance the traffic load of the networks. Compressive sensing is used for reducing the energy consumption of sensor nodes and also to reduce the congestion in the network. This increases the efficiency of the network system.

KEYWORDS: IoT(Internet of Things); Compressive Sensing(CS);Wireless Sensor Network(WSN)

I. INTRODUCTION

The development of agriculture must take the path of modern agriculture. With the rapid development of economy, the agricultural technology research and application has been paid more and more attention, especially the greenhouse has become an important part of efficient agriculture. Greenhouse is a said to be a place that creates the best conditions for plant growth, can change plant growth and avoid influence on plant growth due to outside changing seasons and severe weather. The optimum condition of crop growth is obtained on the basis of taking full use of natural resources by changing greenhouse environment factors such as temperature, humidity, light, and CO_2 concentration [1]

Consequently the yield and quality of crops is forcing agriculture, industry and the information industry to pursue common goals, which are to maximize agricultural output whilst maintaining quality. At present, domestic agricultural greenhouse management mainly uses a traditional mode of manual management, this is based on experience to periodically and manually adjust the light, temperature, humidity as well as irrigation, fertilization and to use artificial cultivation. This method not only leads to higher management costs, but also brings a series of problems, such as low production efficiency, waste of resources and environmental pollution. In view of the disadvantages of present agricultural greenhouse management, the use of information technology to make this management more efficient and intelligent is an important task in the information field.

Networking technology is a new generation of information technology, it is the use of the internet or LAN technology to combine sensors, controllers and computers to connect people and ‘things’, thereby obtaining data, and enabling remote control and intelligent network management [4]. The development of software and hardware provides the technical requisites for intelligent agricultural greenhouses, which means it is possible to widely implement smart systems in greenhouses. Temperature sensors are well developed, so though temperature sensing combined with communication technology, one can communicate temperature information through a wireless network. At the same time, air humidity, soil moisture, light and other sensors are being further developed and these sensors and communication technology provide the necessary useful hardware for use in greenhouses.

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Wireless Sensor Networks (WSNs) are made up of tiny energy sensor nodes, so the main challenging process is to retain the energy level of those nodes for a long period. But, the main problem in wireless sensor technologies are the constrained energy resources (e.g. battery, processing capacity), and they should work as long as possible in the environment while collecting and sending data to the central station. One of the aims in sensor networks research is to reduce the amount of energy consumed by sensor nodes by reducing the communication in the network.

The number of data transmissions can be reduced by using compressive sensing which further balances the traffic load throughout networks [2]. However, the total number of transmissions for data collection by using pure CS is still large. To reduce the number of transmissions in sensor networks, the hybrid method of using CS was proposed. However, the previous works use the CS method on routing trees. The Proposed clustering method uses hybrid CS for sensor networks. The sensor nodes are organized into clusters. Within a cluster, nodes transmit data to cluster head (CH) without using CS. CHs use CS to transmit data to sink. Then, propose a centralized clustering algorithm based on the results obtained from the analytical model. Lastly a distributed implementation of the clustering method is presented. In many sensor network applications, such as environment monitoring systems, sensor nodes need to collect data periodically and transmit them to the data sink through multi hops[5].Data communication contributes majority of energy consumption of sensor nodes according to field experiments. It has become an important issue to reduce the amount of data transmissions in sensor networks. New opportunities for data collection in sensor networks and target localization in sensor is opened up by developing technology of compressive sensing the batteries cannot be replaced or recharged in complex scenarios. To prolong or maximize the network lifetime these batteries should be used efficiently. According to the communication states like transmitting, receiving, listening or sleeping modes, the energy consumption of each nodes varies. Researchers and industries both are working on the mechanism to prolong the lifetime of the node's battery. In communication routing algorithmsdecides which node has to be selected for communication and thus plays very important role in communication system.

II. RELATED WORK

" Ji-chun Zhao,Jun-feng Zhang,Yu Feng ,Jian-xin Guo"et.al proposed a combined work of remote monitoring system with internet and wireless communications. They showed that the greenhouse monitor system is based on IoT technology, that has certain precision of monitor and control. According to the need, surrounding monitor, this system has realized the automatic control on the environmental temperature, humidity factors. And the system has offered a good growth condition, it is easy to operate, the interface is friendly, offering the real time environmental factors in the greenhouse. It can revise environmental control parameters, this system realizes the operation online, also have these characteristics: run reliably, high performance, improve easily[4].

" Lijun Liu, Yang Zhang" et al. designed a greenhouse environment monitoring system based on wireless sensor network using Zigbee, the system integrates detection, wireless communication, alarm, display, control and other functions into one, using temperature and humidity sensor SHTll and light intensity sensor BH1750 for data monitoring, using CC2530 as microprocessor, man-machine interface is realized by using LabVIEW software. And experimented that the system is mobile and flexible, strong expansibility, low cost, low power consumption, the experiment proved the system's measurement accuracy. It can satisfy the demand of the greenhouse monitoring[6].

"Yan Liu Chunhua Bi" et al. proposed a system based on ZigBee and the greenhouse environment is detected by a slave computer. The data collected will be transmitted to a host computer to do the specific operation. That is, by displaying and controlling greenhouse parameters in real time, the host computer can realize real-time monitoring and control of greenhouse temperature, humidity, light, air quality and other environmental parameters. The simulation results show that the system has good stability, low power consumption and good real-time monitoring effect. It can effectively improve the reliability and intelligence of the greenhouse environment monitoring, and reduce the monitoring cost[8].

"Liu Dan Cao Xin Haung Chongwei Ji Liangliang"[7] et al. proposed greenhouse monitoring system by considering CC2530 chip as its core in WSN, the system is made up of front end data acquisition, data processing, data transmission and data reception.The ambient temperature is real time processed by temperature sensor,processed data is send to intermediate node aggregates all data and sends it to PC through serial port; at the same time, staff may view and send it.

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" Baofeng zhang , Lei Yang, Jun Chao Zhu, Yan Zhao" et al. constructed the intelligent monitoring system to monitor the light intensity and CO_2 concentration of strawberries greenhouses that is based on the STM32 single-chip, by which the light intensity and CO_2 concentration can be acquired and displayed at the same time. The serial communication is used to send the detection results to the MCGS touch screen, then the real-time monitoring and the alarm of the light intensity and CO_2 concentration in the greenhouse can be realized. The long-term test results show that the detection accuracy of the light intensity in this system is ± 940Lux, the detection accuracy of the CO_2concentration is ± 40ppm. And compared with the traditional automatic monitoring system, the system runs stably and has low cost, whose precision can meet the requirements of the strawberries greenhouse [1].

" Zhaochan Li, JinlongWang, Russell Higgs, Li Zhou, Wenbin Yuan" proposed a smart system of greenhouse management based on the Internet of Things using sensor networks and web-based technologies. The system consists of sensor networks and a software control system. The sensor network consists of the master control center and various sensors using Zigbee protocols. The hardware control center communicates with a middleware system via serial network interface converters. The middleware communicates with a hardware network using an underlying interface and it also communicates with a web system using an upper interface. The top web system provides users with an interface to view and manage the hardware facilities, so that administrators can thus view the status of agricultural greenhouses and issue commands to the sensors through this system, in order to remotely manage the temperature, humidity and irrigation in the greenhouses [9].

III.PROPOSED SYSTEM

In the proposed system WSN is reconfigured using RF communication. Here the system consists of 1 Master and 2 slave's structure. In this network data compression protocol is used.

The Figure 1. depicts proposed block diagram of the system. The system consist of PIC microcontroller and various sensors.

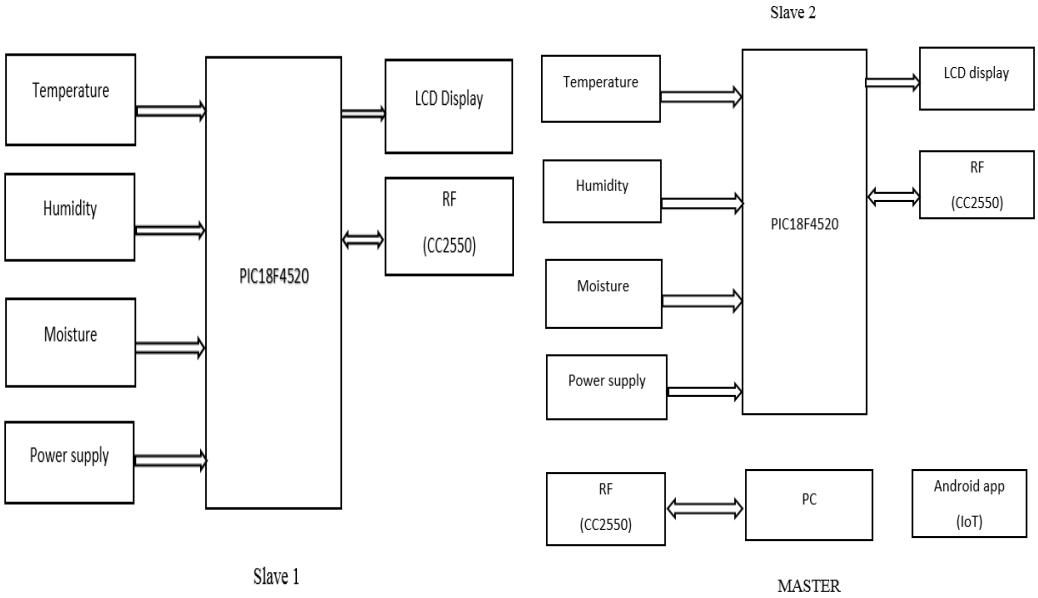

Figure:1 Block Diagram of Proposed System

Here the WSN consists of a master and two slaves. Here, the communication occurs from slave side to master side. If access is given to all the slaves to transmit the data frames directly to master, then the whole network will be flooded with data frames, causing congestion which further reduces the overall efficiency of the WSN.

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To counter these limitations, a data compression protocol is proposed, in which the slaves transmit their frames to their nearest neighbour who is closer to the master. The nest slave will then combine the previous slave's data frame with its own data frame to construct a new data frame. This data frame will have the data of both the slaves with a identifier. In this way, the data is compressed as the frame id is forwarded in the network, until finally it reaches the destination (Master).

III. CONCLUSION AND FUTURE WORK

Agriculture fields are most likely to be far away from central controlling station, in which a suitable link between field and central station has to be in place in order to effectively monitor and operate remote field station without physical attendance of human guard.Wireless Sensor Network used different techniques to collect data and send to cluster head, which in turn leads to more energy consumption with limited battery life and reduces the efficiency of the system. Keeping these issues in view, an IoT based low costmonitoring and control system can be designed and implemented, that will help farmers.

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