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Wi CAN-Farm: Microclimate Data Acquisition and Precision Irrigation Control Based on Hybrid Wired/Wireless Networking Infrastructure

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Abstract: Irrigation has been the highest priority in economic development of India, since, 1947. Due to the wide variation in climatic and geological conditions, our country experiences severe drought in one area while some other part experiences flood. Thus, water available for irrigation has become a precious liquid. Farmers are severely affected by these extreme conditions. Farmers always use fertilizers and natural manures evenly throughout a large field without considering the regional land and micro-climatic conditions. Our venture proposes a hybrid and hybrid wired/remote system way to deal with run this accuracy horticulture cultivates that includes microclimate observing and zone based water system control framework for minimal effort, proficient and viable rural ranch administration.

Key words: Controller area network, LPC1100 microcontroller, GSM, USB and ZigBee, framework, administration

INTRODUCTION

The solution is a technology called precision agriculture. These farms require data acquisition from each region of the cultivated land and they must be transferred to a central monitoring and control unit which is located in a separate control room. A novel approach for flexible wireless automation in real-time environments is explained by Gaderer *et al.* (2008). This technology also, involves controlling the time and amount of irrigation water according to the microclimatic conditions at each region. System and device architecture of a radio based field bus and robust multiloop PID controller design: A successive semi definite programming approach are described by Rauchhaupt (2002) and Bao *et al.* (1999). At present the data transfer between the farming land and the control room is provided by a wired communication system such as a field bus. On the design of multivariable PID controllers via. LMI approach is discussed by Zheng *et al.* (2002). Although, a fully wireless system looks attractive it has some disadvantage like the need for periodical changes of batteries, the signal propagation problem and the non-standard application profiles. Multipath routing using generalized load sharing for wireless sensor networks and multipath routing using generalized load sharing for wireless sensor networks are described by Pazzi and Boukerche (2008).

MATERIALS AND METHODS

Proposed farm: Our project proposes a hybrid wired/wireless network approach to run these precision agriculture farms that involves microclimate monitoring and zone based irrigation control system for low cost, efficient and effective agricultural farm management. Figure 1 shows that the wireless sensor node. This method reduces the amount of water needed for irrigation and also gives the farmer a precise knowledge about the cultivated land condition in order to irrigate and fertilize. Synthesis, growth and characterization of novel semi organic nonlinear optical potassium Boro-Succinate (KBS) single crystals and fast AEM data processing and inversion are explained by Chidambaram *et al.* (2011) and Macnae *et al.* (1998).

Wired/wireless sensor-actuator network: The use of hybrid wired/wireless technologies appears to be the best tradeoff solution. Here, we use Controller Area Network (CAN) in the wired section and IEEE 802.15.4 (DLL-of-ZigBee) in the wireless section. The wireless section is located where high scalability, flexibility, ease of installation and mobility of devices is required. The

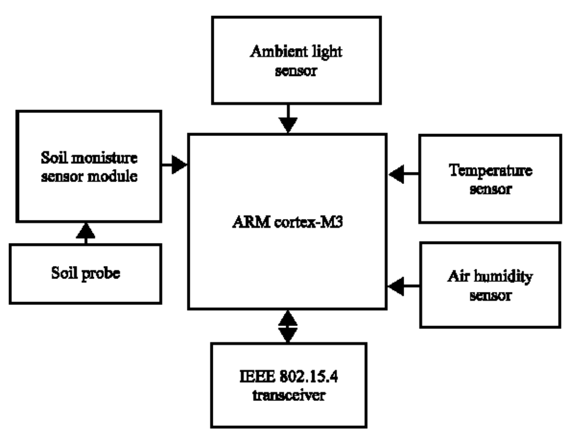

Fig. 1: Wireless sensor node

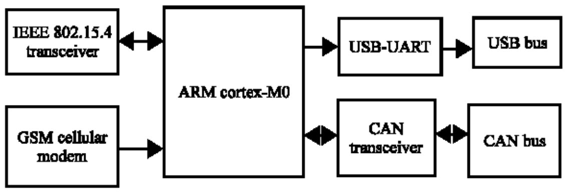

Fig. 2: Control unit

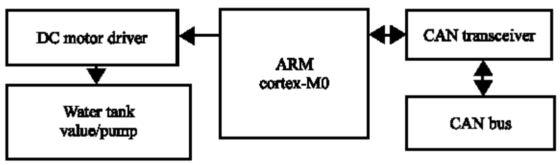

Fig. 3: Motor unit

wired section is mainly used as the control backbone to interconnect the farmland with the control room. Wireless nodes are used to monitor the field sensing the local climatic conditions with an array of sensors for light, air humidity, atmospheric temperature and soil moisture this method represents Fig. 2. Wired nodes are the actuator part of the network that is used to control the water flow using DC motor pumps.

Several such sensor nodes and few controller nodes may cover all the area to irrigate that may be hundreds of acres. The irrigation controller node in the control room receives periodical updates from the sensor nodes and based on the dryness of the region it decides when to open the valve of the motor to irrigate the field associated with it. The central control unit is connected with a PC/Laptop using USB bus that has the all the collected data for viewing and management. The motor valves can be controlled ON and OFF from the PC represents in Fig. 3. It is also connected with a GSM module that enables the farmer to send control commands to the irrigation controller through SMS. The system sends alert messages when met with bad conditions or unauthorized motor pump control. The central control unit acts as a bridge between different network protocols-CAN, IEEE 802.15.4, USB and GSM.

Uses the latest microcontroller from ARM: LPC1100 series of 32 bit ARM Cortex-M0 microcontrollers are used to control and coordinate all the nodes in the hybrid network. This microcontroller is chosen for its low power, yet, high performance characteristics. This is a product of NxP semiconductors.

RESULTS AND DISCUSSION

Recording of variation of temperature and humidity along with time is given in Table 1. Field observations for various crops have been discussed in past by some researchers. Optimum temperature range is very important for agriculture and is to be maintained for maximum dry matter accumulation. It is well known that for wheat and some other important crops the optimum temperature required is 25°C. We set the upper threshold value of temperature to be 27°C and lower threshold value to be 22°C. As discussed above the actuators are controlled by the threshold value of the temperature and maintain the required optimum temperature (Fig. 4 and Fig. 5).

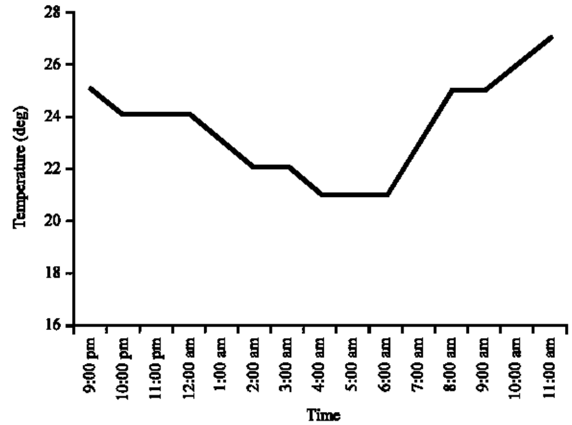

Fig. 4: Temperature variation curve

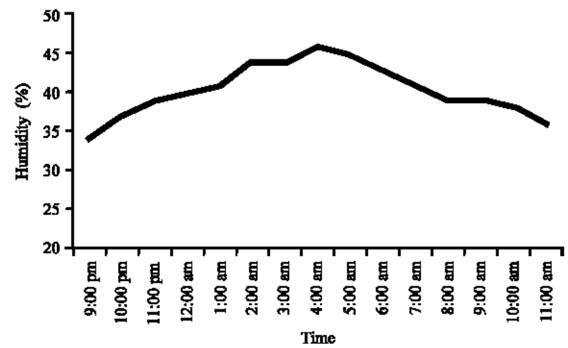

Fig. 5: Humidity variation curve

Table 1: Observations for the crop in duration February-March

Time	Temperature (°C)	Humidity (RH) (%)
9:00 pm	25	34
10:00 pm	24	37
11:00 pm	24	39
12:00 am	24	40
1:00 am	23	41
2:00 am	22	44
3:00 am	22	44
4:00 am	21	46
5:00 am	21	45
6:00 am	21	43
7:00 am	23	41
8:00 am	25	39
9:00 am	25	39
10:00 am	26	38

The graphical representation of variation between temperature and time with the controlling action of actuator is shown in Fig. 4 whereas Fig. 5 relates the variation of relative humidity at that temperature.

CONCLUSION

This study has displayed a correspondence framework for the observing and control of nurseries. This framework is portrayed by some appealing components, for instance, the utilization of a cross breed wired/remote correspondence framework which rearranges the arrangement of sensors and their restriction on the ground and makes the framework very adaptable. Besides, other than utilizing two distinct systems (wired and remote), the application layer in light of SDS gives a brought together administration set which can be utilized by the application forms without the need to recognize if a gadget has a place with the wired or remote arrange. Along these lines, all gadgets are overseen as though they have a place to a solitary system. This required the usage of a appropriate extension that can shroud the contrasts between the two conventions and make the framework uniform. The framework has additionally been in the blink of an eye tried in an outside field as yet demonstrating its adaptability and its capacity to work in various situations.

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