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WiCAN-Farm: Microclimate Data Acquisition and Precision Irrigation Control based on Hybrid Wired/Wireless Networking Infrastructure

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Abstract: Since 1947, irrigation has been India's top economic development objective. Because of the enormous difference in climatic and geological factors, our nation endures severe drought in one place and flooding in another. As a result, irrigation water has become a valuable commodity. These harsh weather conditions have a significant impact on farmers.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. This article demonstrated a correspondence architecture for monitoring and controlling facilities. 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.

Keywords: Hybrid Wired, Wireless Networking. CAN, Data Acquisition, Precision Irrigation.

1. Introduction

Precision agriculture is a way of managing that collects, processes, and analyses temporal, spatial, and individual data, combining it with other information to support management decisions based on estimated variability for improved resource use performance, economic output, value, profit growth, and sustainable development of crop yields.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 the controller unit is installed in a separate control center.This technology also involves controlling the time and amount of irrigation water according to the microclimatic conditions at each region. A wired network infrastructure, such as a field bus, is now used to transport data between the farmed area and the control center. Although a totally wireless system appears appealing, it has several

drawbacks such as the requirement for frequent battery replacements, signal propagation issues, and non-standard application profiles.

The author developed a communication architecture for monitoring and regulating nursery in this study. The framework is characterized by appealing components, for example, the utilization of cross breed distant correspondence framework, which reorganizes the arrangement of sensors and their limitations on the ground and makes the framework extremely flexible.Furthermore, rather than using two unique systems (wired and remote), the Application Layer based on SDS offers a consolidated administration set that can be utilized by application forms without the requirement to recognize whether a gadget is associated with the wired or remote arrange. As a result, all devices are managed as if they were part of a single system.

2. Literature Survey

Wireless networks are used to transition industrial control from exclusively wire-based to wireless, which necessitates the deployment of a secure and robust communication infrastructure with real-time capabilities. Such infrastructures, which are based on wireless communication technologies, can be used to gain greater flexibility within each phase of a manufacturing process, enabling for the creation of novel new applications [1].This study offers a wireless control network scheduling approach for factory automation utilizing IEEE 802.15.4 networks. IEEE 802.15.4 super frames are utilized for the delivery of real-time mixed data for wireless control systems [2] [3].

A WSNS network is made up of several sensor nodes with limited power and computing capabilities. Due to the limited connection range and high density of sensor nodes, sensor network packet forwarding is typically performed using multi-hop data transfer [4]. As a consequence, routing in networks has been an important field of research throughout the last decades. Multipath routing is now frequently utilized in wireless sensor networks to increase network performance by making better use of existing network resources [5].Because of its extensive capabilities and ever-expanding variety of applications, this technology is one of the most promising emerging technologies [9].

WSNs, on the other hand, have a relatively short lifespan due to the limited energy capacity of their sensor nodes. As a result, conservation of energy has been identified as the most essential WSN research objective. The most energy-intensive function of a WSN is radio transmission [10].The energy restrictions of sensors, imposed by the limitations of their built-in batteries, significantly shorten the lifespan of Wireless Sensor Networks (WSNs). These ad hoc networks may be used for a number of reasons, such as spying and target tracking. Unfortunately, because sensor nodes have limited power resources, optimizing their utilization is a major goal in creating power-aware WSNs [11].

The fundamental purpose of this study [12] is to present an Agent-Based Model for analyzing malware propagation on these networks, as well as its agents, coefficients, and transition rules. Finally, there are several simulations of the suggested model supplied.Hybrid wireless networks are a potential networking option for overcoming the limits of infrastructure wireless networks and providing Internet access to ad hoc networks. This article [13] initially examines the requirements for hybrid network implementation in various application situations. Then, in order to attain optimal performance, two routing strategies suited for various traffic patterns in hybrid networks are provided.

3. Proposed Method

Our project proposes a hybrid wired/wireless network [14] 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. 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 [15]. Figure 1 shows the Architecture of the WSNs.

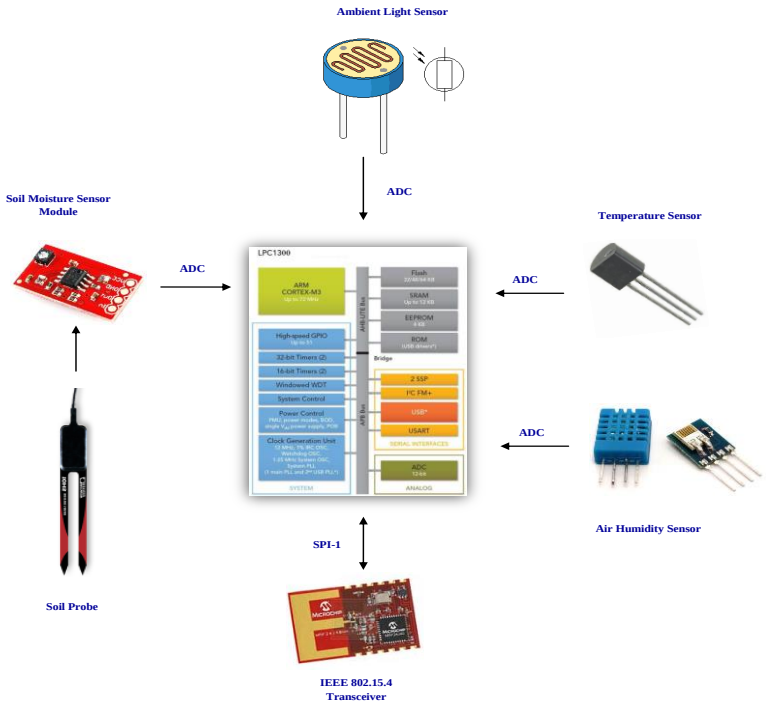

Figure 1: Wireless Sensor Node

3.1 Wired/Wireless Sensor-Actuator Network

Here we use Controller Area Network (CAN) [8] 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 wired section is mainly used as the control backbone to interconnect the farmland with the control room. Wireless nodes [6] 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. Wired nodes are the actuator part of the network that is used to control the water flow using DC Motor pumps. Figure 2 shows the Motor unit.

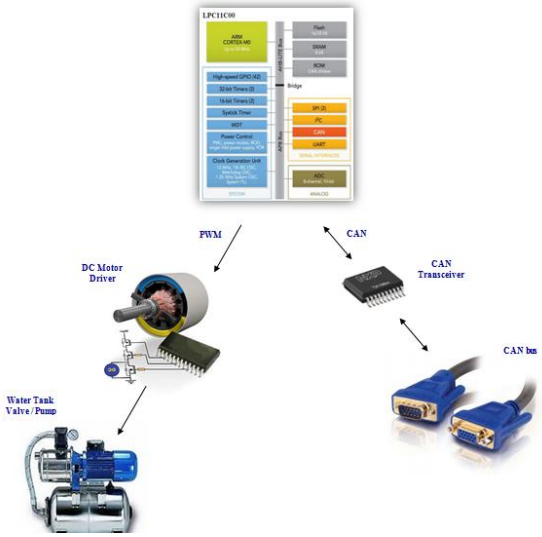

Figure 2: Motor Unit

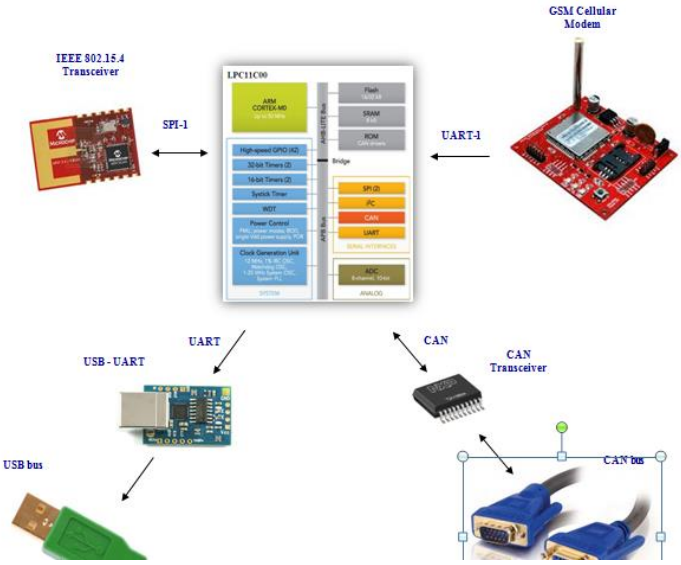

Figure 3: Control Unit

Several such sensor nodes and a few controller nodes could cover the whole irrigated region, which may be hundreds of acres [7]. The irrigation controller node in the control room receives periodic updates from the sensor nodes and determines when to open the motor's valve to water the field connected with it depending on the dryness of the region. The central control unit is linked to a PC/Laptop by a USB connection, which contains all of the collected data for viewing and administration. The motor valves may be turned on and off using the PC. It is also linked to a GSM module, which allows the farmer to transmit control orders 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. Figure 3 shows the control unit.

4. Results and Implementations

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.

NOTE: sensor 1 node control PUMP1 node and sensor2 node control PUMP2 node.

❖ In demo process we are combined together of two nodes.
- Wire node(LPC11C14_MVB14 board)

- Wireless node or sensor node(LPC 1313_MVB11 board)

❖ NOTE: In demo start before you check this, Soil moisture value is dry state or not.
❖ After start wireless node means sensor node, we use sensor 1 and sensor 2 node.
❖ Switch ON the sensor1 node first and then sensor2 node.
❖ After we start wire node, here wire nodes are three kinds of node.
- Gate way node(Hybrid of wire and wireless node)
- Pump1 node
- Pump2 node

❖ Gateway node is connect USB to TTL board on USB cable to CPU and in this wire nodes are connecting through CAN cable.
❖ The two sensor nodes are connecting MIWI (D2 AND D4 LEDs ON) and then connect) MIWI gateway node (D2 AND D4 LEDs ON).
❖ Once connected that MIWI, open the FLASH MAGIC and its showing input and output screen, you get the (WELCOME) message from GSM side.
❖ After receiving the message that the FLASH MAGIC output screen display the ENTER YOU MOBILE NUMBER.
❖ FLASH MAGIC output and input screen like this

ENTER YOUR MOBILE NUMBER:
xxxxxxxxxx
YOUR PASSWORD IS
xxxxxxxxxx

Table 1:Auto Mode

SENSOR 1 NODE				SENSOR 2 NODE			
TEMP	HUMIDITY	LIGHT	MOISTURE	TEMP	LIGHT	MOISTURE	HUMIDITY
33	10	0	100	33	10	0	100
33	12	0	100	33	12	0	100
33	13	0	100	33	13	0	100

❖ FLASH MAGIC output screen show the enter your mobile number, once you the one mobile number that one is fixed, you cannot change the mid of demo, so maintain the same no.
❖ What number you type the screen that number gets the welcome message for indicates for staring the demo.
❖ The output screen is like given above; its default mode of automatic mode and its updating sensor nodes values are automatically.

- You want to change the mode press SPACE+ENTER , its asking for you, you want change the manual mode, just command on screen ,like yes or no , if its yes .
- Manual mode is show the list of command,
    - Motor1 on means PUMP1 node motor will be run.
    - Motor1 off means PUMP1 node motor will be off.
    - Motor2 on means PUMP2 node motor will be run.
    - Motor2 off means PUMP2 node motor will be off.
- After you want to change the mode, press SPACE+ENTER, you want to automatic mode as shown in Table 1..
- Yes means the automatic mode updated the list of sensor node, soil moisture and humidity values and motor to run, shown in given below in Table 2.

Table 2: Sensor Values

Sensor node1 Soil moisture	Sensor node1 Humidity	Sensor node2 Soil moisture	Sensor node2 Humidity	PUMP1 MOTOR	PUMP2 MOTOR
0	40	0	40	RUN	RUN
0	60	0	60	RUN	RUN
1	40	1	40	RUN	RUN
1	60	1	60	OFF	OFF

- Soil moisture value is shown in Table 3.

Table 3: Soil Moisture Value

Insert jumper	1
Remove jumper	o

- Humidity sensor value is change by commands , the command is YOU WANT CHANGE MANNUAL MODE, you type No and fix the humidity value(for example 50) , NOTE: insert

the humidity sensor in water bottle for change in value , if you insert get humidity value and its take change the value.

- Humidity sensor value is shown in Table 4.

Table 4: Humidity Sensor value

Insert the bottle	50,60,70
Remove from bottle	70,60,50,40

Table 5: GSM Control Mode

motor1 on	PUMP1 MOTOR ON
motor 1 off	PUMP1 MOTOR OFF
motor2 on	PUMP2 MOTOR ON
motor2 off	PUMP2 MOTOR OFF

- So this is automatic mode and other one is SMS control mode.
- NOTE: SMS control mode to change automatic mode, once you send the message to the GSM and its stop the updating. To stop all motors in automatic mode.
- SMS control mode is just send the message to GSM mode as shown in Table 5
- SMS control disable, you send the message to GSM, and it will start updating for automatic mode.
- We are seen auto, manual, SMS mode to controller the farm land.

5. Conclusion

This article demonstrated a correspondence architecture for monitoring and controlling nurseries. The framework is portrayed by appealing components, at instance, the utilization of cross breed 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 theneed 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.

References

1. G. Gaderer, et al., “A novel approach for flexible wireless automation in real-time environments,” 2008.
2. L. Rauchhaupt, “System and device architecture of a radio based fieldbus—The RFieldbus system,” 2002.
3. J. Bao, et al, “Robust multiloop PID controller design: A successive semidefinite programming approach,” 1999.
4. F. Zheng, et al, “On the design of multivariable PID controllers via LMI approach,” 2002.
5. Gupta, Suneet Kumar, PratyayKuila, and Prasanta K. Jana. "Energy efficient multipath routing for wireless sensor networks: A genetic algorithm approach." In *2016 international conference on advances in computing, communications and informatics (ICACCI)*, pp. 1735-1740. IEEE, 2016.
6. R. W. N. Pazzi and A. Boukerche, “Mobile data collector strategy for delay-sensitive applications over wireless sensor networks,” 2008.
7. Wang, Y. O. N. G., and Z. Bian Wang. "Wireless sensor networks." In *ch. Compression Techniques for Wireless Sensor Networks*, pp. 207-231. Kluwer Academic Publishers, 2004.
8. Karray, Fatma, Mohamed W. Jmal, Alberto Garcia-Ortiz, Mohamed Abid, and Abdulfattah M. Obeid. "A comprehensive survey on wireless sensor node hardware platforms." *Computer Networks* 144 (2018): 89-110.
9. Nakas, Christos, DionisisKandris, and Georgios Visvardis. "Energy efficient routing in wireless sensor networks: a comprehensive survey." *Algorithms* 13, no. 3 (2020): 72.
10. Li, Cheng, Tomas M. Fernnandez-Steeger, Jo Agila Bitsch Link, Matthias May, and Rafig Azzam. "Use of MEMS accelerometers/inclinometers as a geotechnical monitoring method for ground subsidence." *Acta Geodyn. Geomater* 11, no. 4 (2014): 337-349.

11. Gbadouissa, Jocelyn EdinioZacko, Ado Adamou Abba Ari, ChafiqTitouna, Abdelhak Mourad Gueroui, and Ousmane Thiare. "HGC: HyperGraph based Clustering scheme for power aware wireless sensor networks." *Future Generation Computer Systems* 105 (2020): 175-183.
12. Fahmy, Hossam Mahmoud Ahmad. "Wireless sensor networks essentials." In *Wireless Sensor Networks*, pp. 3-39. Springer, Cham, 2020.
13. Sun, Yuan, and Elizabeth M. Belding-Royer. "Application-oriented routing in hybrid wireless networks." In *IEEE International Conference on Communications, 2003. ICC'03.*, vol. 1, pp. 502-506. IEEE, 2003.
14. Venkataraman, Hrishikesh, Harald Haas, Yeonwoo Lee, Sangboh Yun, and Stephen McLaughlin. "Performance analysis for hybrid wireless networks." In *2005 IEEE 16th International Symposium on Personal, Indoor and Mobile Radio Communications*, vol. 3, pp. 1742-1746. IEEE, 2005.
15. Prakash, Gyan, Bhaskar Vyas, and Venkata Reddy Kethu. "Secure & efficient audit service outsourcing for data integrity in clouds." *International Journal of MC Square Scientific Research* 6, no. 1 (2014): 5-60.