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Monitoring the agriculture in Remote areas using zigbee

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Abstract*–*Precision agriculture could be a farming management conception supported perceptive, measure and responding to entomb and intra-field variability in crops. By assembling real time information on weather ,soil and air quality, crop maturity associate do their issues predictive analytics will be accustomed create higher selections for the longer term. This paper proposes a coffee power, low cost, sturdy information assortment system to come up with and gather information autonomously in isolated or remote areas. The device module collects soil wetness and temperature information and air temperature and wetness information that's then gathered sporadically by a line following golem that uploads the keep information from the device module via zigbee communication for further analysis

Keywords-*Agricultural Monitoring System; Data Collection System; Remote Areas; Real Time System; Zigbee Communication*

I. INTRODUCTION

The prediction for large growth has created agriculture management practices necessary .One such follow ,precision agriculture ,can considerably scale back the quantity of nutrient and alternative crop in puts used whereas boosting yields, creating it an especially profitable business. With exactness agriculture centre collect and method real time knowledge relating to soil and air temperature and humidness gathered by sensors placed throughout the yields being armed .This knowledge helps farmers create the simplest selections relating to planting, fertilizing and gather crops. presently this technology needs considerably resources and it infrastructures of its utilized by larger firms .This paper explores a smaller scale nevertheless strong system, utilizing zigbee technology, which may be utilized by smaller farms and or farms in areas that don't have access to a wireless fidelity network that's needed for the big scale systems presently in use. The planned system combines a sensing element module along period of time knowledge relating to soil temperature and wetness, and air temperature and humidness with a golem which will autonomously locomotive the sensing element module and transfer the info via zigbee communication. During this means there's no would like for a rich or expansive IT infrastructure and/or wireless fidelity, massive| and enormous and huge amounts of knowledge may be collected for more analysis while not the requirement for the sensing element module/s to contain large storage devices. The implementation of a custom RTOS adds to the low value and high potency of the projected system.

II. RELATED WORKS

There are vital contributions and development within the field of preciseness agriculture, and lots of ways are created for gathering and process the info. There has been a selected specialize in developing wireless device networks for assortment of the info, since wired systems have proved to be too high-ticket and cumbersome to manage in agricultural environments. Varied proposals, like [4], [5], and [6] use WLAN technology to make a commercial hoc wireless device network. WLAN is a perfect technology for this application since the little; low power modems might simply be designed to speak with one another across an oversized space of land. but this proposal aims to ultimately leverage sensors equipped with Zigbee, that are quickly turning into a well-liked, low price choice on the market with a good vary of sensors. There are proposals on agricultural knowledge gathering victimization ZIGBEE, like [2], however this proposal solely sets up one network that's restricted to the vary of the ZIGBEE transceivers. This proposal uses a line following mechanism to extend the realm of land that may be researched.

III. RELEVANT TECHNOLOGIES

A. Arduino Mega 2560

The Arduino Mega 2560 is associate degree open supply physics platform supported the ATmega2560, associate degree Atmel Jewish calendar month R 8-bit microcontroller. The board has fifty four digital I/O pins, sixteen analog inputs, 4 UARTs, a sixteen Mc quartz oscillator, a USB association, an influence jack, associate degree ICSP header and a button. The Arduino Mega 2560 has 256 K of non-volatile storage, eight K of SRAM and four K of EEPROM. [5] The Arduino additionally has the aptitude of communication with a laptop, another Arduino, or alternative microcontrollers and also the software system Serial library permits for serial communication on any of the board's digital pins. The Arduino IDE permits users to jot down programs (called a sketch) mistreatment C or C++ and comes with an intensive set of libraries to produce easy accessibility to a range of functions.

B. ZigBee

ZigBee may be a cheap, low-power; wireless mesh network commonplace targeted at the wide development of long battery life devices in wireless management and observation applications. Zigbee devices have low latency, that more reduces average current. ZigBee chips area unit generally integrated with radios and with microcontrollers that have between 60-256 KB of non-volatile storage. ZigBee operates within the industrial, scientific and medical (ISM) radio bands: two.4 gigabyte in most jurisdictions worldwide; 784 Mc in China, 868 Mc in Europe and 915 Mc within the USA and Australia. knowledge rates vary from twenty kbit/s (868 Mc band) to 250 kbit/s (2.4 gigabyte band)

C. I2C (Inter-Integrated Circuit)

I2C could be a 2 wire interface, clock and information line, that permits multiple devices to be connected to a similar 2 wires as long as they need a distinct 7-bit 12C address. The 7-bit address vary permits up to 127 coincident devices, but this is often fantastic because of physical limitations.

D. KNOS (Kiet Nguyen operative system)

KNOS could be a period of time package developed for the Atmel ATmega2560 small controller. KNOS relies on the open supply Riverside/Irvine package (RIOS). RIOS could be task hardware, written in C, developed for brand spanking new embedded programmers World Health Organization need basic support for multiple tasks. 3 versions are accessible which will offer basic preventive or non-preemptive multitasking capabilities. KNOS uses the preventive RIOS hardware and adds dispatching and inter-task communication to become a completely completed package with the aptitude to schedule tasks and synchronize resource sharing. To boot, with KNOSs further task block feature, if a task is blocked, the system is capable of crucial once the task ought to be sent once more.

IV. SYSTEM IMPLEMENTATION

A. Data Droid Sensors and Actuators

The Data Droid is formed of 3 sensors, every victimisation the I2C (Inter-Integrated Circuit) communication protocol. The Infrared (IR) and Color sensing element belong to the toy Mindstorms EV3 wares and therefore the line follower sensing element, the Line Leader v2 (LL), is factory-made by Mind Sensors. Management of the information Droid is administrated by 2 EV3 giant Motors. during this application, the IR sensing element is employed for the information Droid's object detection perform and is designed to control in proximity mode. during this mode the sensing element can notice a forward trying objects' proximity from the information droid. The proximity could be a nonlinear performs of distance shown in Figure I. The color sensing element is capable of police investigation up to eight colours (see Figure 2) and is employed to notice the red stop line initiating the information transfer. The LL sensing element is a complicated line follower sensing element that comes with an inbuilt pelvic inflammatory disease controller (proportional integral-derivative controller). The LL sensing element was designed to follow a point of reference on a black surface. Steering of the information Droid is administrated by adjusting the motor speed of every of the 2 motors.

B. Data Droid System Architecture

The Data Droid was developed mistreatment the Arduino Mega ADK board. This platform was chosen supported the range of shields offered, that may be paired with the board to expand practicality. during this case the Open Electrons NXShield-MX was the protect chosen to attach the required parts the Arduino board. Within the case of the IR and color

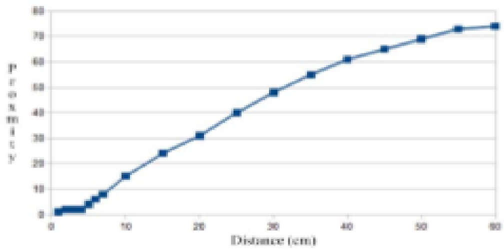

Figure 1: IR Sensor Proximity Reading

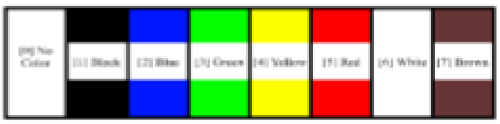

Figure 2: Color Sensor Color Readings

sensors a UART to I2C adapter was needed as these sensors each
use universal asynchronous receiver/transmitter (UART) communication rather than I2C. The NXShield-MX has 2 banks with completely different I2C addresses. Every bank has 2 motors and 2 12C ports capable of hardware or code 12C communication. However, just one port, BAS 1, uses hardware I2C therefore so as to avoid processor intensive code I2C, all sensors were connected to BAS one through a MindSensors Port Splitter. The detector module, shown in figure four, is comprised of associate degree Arduino microcontroller, a detector cluster, a zigBee Silver electronic equipment, associate degree liquid crystal {display|LCD|digital display alphanumeric display} display and is power-driven by a 9V battery. The detector cluster includes three detectors: I)DHT11-a low value digital sensor that monitors air temperature starting from 0-50 degC and air humidness starting from 20-80%; 2) DS 18820- a 1 wire, digital, waterproof detector that monitors soil temperature starting from 10-85 degC; 3) SENO 114- associate degree analog detector that monitors soil wet. The open supply libraries created on the market by the DHT11 and DS 18B20 were utilized. the information gathered from every of the 3 sensors is keep in an exceedingly sixteen computer memory unit array in conjunction with a timestamp and 2-byte check shown in figure six. Every detector activity is keep as a brief knowledge kind and also the millisO operate is employed to come up with the timestamp that may track the time in relation to the beginning of the program every sixteen computer memory unit array is written to EEPROM each ten minutes. The last memory address in EEPROM is employed to take care of associate degree EEPROM write index that is updated with the address of the last storage location that was written to. The EEPROM write index is documented throughout program initialization so within the event of power loss, the program will resume memory storage from the primary on the Arduino provides there's sufficient space for storing for one day's price of knowledge (16 B x six I hour x twenty four hour = 2304 B). If memory limits area unit exceeded before the information is uploaded to the information Droid, the detector module overwrites keep knowledge on initial primary in first out (FIFO) basis.

V.TESTING

Testing of the KNOS hardware was done otherwise for the Data Droid and therefore the detector Module. The Data Droid used a 16-bit hardware timer setup to roll over ever262ms.The detector Module
the inbuilt millisO
Perform that depends on the core Arduino timer ISR. The Data Droid's methodology is way a lot of correct since the hardware timer can invariably tick, even in interrupts. This methodology is actually engineered into the KNOS system. The millisO service relies son the ISR incrementing the tick values to calculate the timer. So if there's serious interrupt load the millisO perform are going to be less correct.

A. Data Droid

The Data Droid uses a hardware timer to estimate execution times. At the beginning of each task, except for output Timer Information Task (OTIT), Get begin TimeO is termed. This can scan the hardware timer and store it in Tasks[i]. Start Time. The Tasks[i].Frequency will be incremented, this keeps track of the number of times the task has been dead. At the top of the task, Get finish TimeO are going to be known as. This service can calculate the execution time and interval time and store it within the matching KNOS TASK T component. Execution time is what proportion time the task took to execute, this can embody any preemption. Interval time is what proportion time since the task was last known as. On average, the interval time ought to match the task's amount. Once OTIT is scheduled, the common execution and interval times' area unit calculated.

B. Sensor Module

Testing for the sensor module focused on time to complete tasks and task scheduling interference. First, the sensor module was tested to determine how long each individual task takes to run. Next, all tasks were scheduled with the same execution period of 2 seconds. The output for task execution in a single test was:
EEPROM write start: 1999
EEPROM write ends: 2055
Bluetooth Tx start: 2055
Bluetooth Tx end: 2056
Fast sensor read start: 2056
Fast sensor read end: 2066
Slow sensor read start: 2067
Slow sensor read end: 2155
Print display start: 2155
Print display ends: 2157
The above sequence shows that the scheduler executes
tasks in order of priority, with minimal time lost on context switching. Finally, preemption was tested by running two tasks; the fast sensor read task was scheduled every 50 ms seconds and the slow sensor read task was scheduled every 2 seconds. The output at 2 seconds was:
Fast sensor read start: 1999
Fast sensor read end: 2001
Slow sensor read start: 2002
Fast sensor read start: 2050
Fast sensor read end: 2052
Slow sensor read end: 2089
The above sequence proves that a higher priority task will suspend a lower priority task until the higher priority task has completed.

C. Communication

Testing for the sensor module focused on the time to send an individual packet, and time to send a full load of data. Adding serial output for debugging purposes, the following is data received at the master:
Packet start: 71831
SOT0000000000000000000000007CFOOO I00D7
Packet end: 71834
The above demonstrates that transmission of a single packet takes approximately 3 ms for the sender to transmit. Execution time to send a packet and receive a response from the data collector was tested and found to be an average of 11ms:
Packet start: 81309
SOT0000000000000000000000007CFOOO I00D7
Packet end: 81312
OK
Packet end: 81320

Testing for an upload of a full EEPROM, the slave sends 255 packets with a total upload time of approximately 4.3 seconds. This is slightly longer than expected, given the time for an individual transmission. However, this time was measured while all tasks were running on both systems, and includes retries for lost packets.

VI. CONCLUSION

The precision agriculture system proposed in this paper offers a low cost, easily integrated solution for data gathering in remote regions. The system was designed using a custom operating system to fully control and optimize system tasks, and is proven to efficiently and effectively gather and transmit data for further processing. The system could easily be expanded to support any number of sensor modules, allowing for a flexible solution for precision agriculture.

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