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自适应**Tree-Mesh**结构的大棚无线监测网络设计

Design of adaptive tree-mesh hybrid wireless sensor networks for greenhouses

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英文关键词:sensors topology monitoring Tree-Mesh ZigBee CC2530 adaptive low power consumption

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中文摘要:

针对大棚基地作物状态及环境信息的无线采集的需求，设计了改进的分簇Tree-Mesh混合拓扑结构无线传感器网络，并利用ZigBee实现了组网和多跳通信，以CC253
心设计了多传感器无线节点硬件系统，基于Z-Stack协议栈设计了有限状态机节点程序。同时，针对无线节点低功耗和网络信息低冗余的要求，设计了基于接收信号强
示的最佳发射功率自适应机制，和基于感知数据差值的最小传输数据冗余自适应机制。试验结果表明，节点单跳和多跳通信速率典型值分别为20与0.3 kb/s，采用干电
电和直流供电的节点通信距离分别可达30和90 m。仿真结果证明采用低功耗自适应机制的节点功耗降低了38.44%，可用作大棚基地的环境监测。

英文摘要:

Wireless sensor networks have been widely utilized in agricultural production in such as crop information monitoring systems, agricultural facilities' wireless control systems
The wireless sensor networks could promote the development of agricultural information and intelligence, and more research has been focused on using ZigBee wireless technolo
build the networks in recent years. To collect the base crop status and environmental information of greenhouses in a wireless way, a wireless sensor monitoring network system
designed. The basic work of this paper was the software and hardware system design; further work is projected to be low-power adaptive mechanism design. In analyzing the
distribution characteristics of the greenhouse base, it could be seen that the greenhouses were concentrated in their distribution, but independent from each other. So the networ
topology architecture was designed as clustering Tree-Mesh hybrid topology architecture, and the nodes of the cluster belonged to the same greenhouse. The network was built
by a coordinator, and a large number of routers and sensor nodes were joined in. The coordinator was a sink node, it was designed as a gateway, and there were some routers whi
played the role of cluster head in the network. The clustering Tree-Mesh hybrid network was built in two steps: First, the mesh network was established by the coordinator and cl
head. Then, the tree network was built by the cluster head, and the tree was a cluster with routers and sensor nodes. The system utilized ZigBee to build the wireless sensor netw
and multi-hop communication, and the hardware of a single chip multi-sensor wireless node based CC2530 was designed. The modular design of the hardware subsystem was
composed of a radio module, sensor module and power module. The finite state machine node software and the low-power improvement were designed based on Z-Stack. The sta
ran on a task allocation mechanism that was similar to the embedded operating system. According to the wireless channel quality of the motionless node, the best transmit power
adaptive mechanism based Received Signal Strength Indication was designed, and the node adjusted the transmission power to get a credible communication link. According to t
energy consumption distribution of the node subsystem, to reduce the energy consumption of the wireless transmission, a minimum data transmission redundancy adaptive
mechanism based perceptual data difference value was designed. And the node dropped the sensor data which had less information to avoid frequent wireless transmission. Wit
these adaptive mechanisms, the node could meet the requirements of low power consumption and low network data redundancy. The test results showed that, when the transmitt
power is 1 mW, the typical data rate of point-to-point communication is 20 kb/s, and of multi-hop is 0.3 kb/s. The communication distance of the node with the 5th battery powere
up to 30 m, and DC is 90 m. The theoretical simulation analysis showed that the energy consumption of the low-power adaptive mechanism node reduces by 38.44%. The system
meet the greenhouse base environmental monitoring application.

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