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兰花大棚内无线传感器网络433MHz信道传播特性试验

Experiment of propagation characteristics based on 433MHz channel of WSN in orchid greenhouse

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中文摘要:

不同的应用环境对无线传感器网络的性能有一定的影响。该文针对兰花大棚环境中无线传感器网络节点部署的要求及其应用环境的特性, 以433 MHz为载波频率, 研究了无线射频信号的传播特性和无线信号与影响因素之间的关系, 影响因素包括发射功率、数据包长度、距离、发射端位置等参数, 获得了接收信号强度、丢包率等数据, 并进行了统计分析。试验结果表明, 该无线传感器网络信号的衰减符合对数模型, 其决定系数 R^2 最大为0.9246, 最小为0.8753; 发射功率为0和-5 dBm时, 信号较强、通信成功率较高; 发射功率处在0和-20 dBm时接收信号强度波动较大; 在数据传输速率为1.2 kbps、和调制扩频为高斯频移键控方式等参数确定的情况下数据包的长度对丢包率的影响很小。在上述试验研究的基础上, 建立了发射功率和接收信号强度之间的关系模型, 模型参数与发射功率之间、传播环境因子 n 与发射功率之间成二次多项式关系, 相关系数分别达到0.9967和0.8686; 验证试验结果表明: 该模型可以较好地预测不同发射功率不同通信距离的接收信号强度, 为兰花大棚无线传感器网络的组建提供支持。此外, 设计了接收信号强度三维曲面图和等高曲线图, 可直观反映兰花大棚环境下无线信号的传播特性, 为今后无线节点布置与组网提供依据。

英文摘要:

Abstract: There were very few studies on the propagation characteristics of wireless sensor networks in an orchid greenhouse. For deploying a wireless sensor networks system and studying the channel characteristics under orchid greenhouse, the relationship between radio frequency signal propagation characteristics and radio signals influencing factors was studied with a 433MHz carrier frequency for configuring wireless sensor networks in an orchid greenhouse. At first, the curves of the received signal strength had less fluctuation in a playground than in a greenhouse. From the contrast experiment in both greenhouse and playground, the results showed that the orchid greenhouse had a great impact on the received signal strength of wireless sensor networks. During the experiments the transmitting power, packet length, communication distance, and the location of the source of the transmitting signal had changed for obtaining the received signal strength and the packet loss rate. The experiments demonstrated that the relationship of the received signal strength and communication distance caused attenuation to exist according to a logarithmic model, and the regression coefficient R^2 was in the range of 0.9246 and 0.8753. When the transmitting power was 0 dBm or -5 dBm, the wireless signal communication success rate got higher. When the transmitting power was 0 dBm or -20 dBm, the received signal strength index (RSSI) would gain more fluctuations. Furthermore, when the data transmission rate was 1.2 kbps, the packet length had little effect on the packet loss rate. The regression analysis results demonstrated the regression parameters A and the transmitting power were quadratic relationship, and it was a quadratic regression equation between the environmental factor n and transmitting power. The curved surface and filled contour of RSSI were built by analyzing the data. The wireless signal propagation characteristics of the orchid greenhouse environment were intuitively and comprehensively reflected. Besides, a model was built for calculating the received signal strength of 433 MHz in an orchid greenhouse. The simplified math model was developed for the need of engineering. Meantime, the math model could be used for predicting the received signal strength at different transmitting powers and different communication distances by the verification experiment. Finally, this research could provide specific and detailed reference for a configured WSN system in orchid greenhouses.

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