Development of Telemetry System for Light Intensity Measurement by Using a Wireless LAN

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Abstract
A remote measuring system using wireless LAN (Local Area Network) for light intensity measurement has been developed. It made use of a socket programming and TCP/IP protocol. The system consisted of a light source, an OPT 101 sensor, an ADC 0804, an AT89C51 microcontroller, and a wireless LAN system. The result of sensor calibrations showed a linear relationship between light intensity and sensor output (I = 5.6337 V- 4.4912; R^2 = 0.9913). The light intensity varied from 51 to 3,912 lux. By using Delphi and assembler utility for microcontroller, the system could be automated and displayed in a form of light intensity values both on the server and client computers. In order to see the influence of the server and client computer distance receptivity on the measurement result, the signal strength was also measured by using Net Stumbler software whose distances were varied from 2 to 226 m.

Key words: Light intensity sensor, wireless LAN, socket programming, TCP/IP protocol.

1. Introduction

Several methods of telemetry (*i.e.* remote measuring system) have been developed either by using a telephone line, a radio, or a computer network. Nowadays, computer networks have rapidly developed, from local area network (LAN) to international network (internet)[1-3]. The recent network technology has been using wireless technology. We can use the networks to develop a telemetry system for measuring something far from the measuring place.

We have conducted an experiment on sensor and telemetry by using UTP cable LAN connection [4-8]. We attempted to design a remote temperature measuring system by using a wireless LAN (Local Area Network). The system consisted of a light intensity sensor, a computer interface, and a wireless LAN.

2. Experiment

2.1 Designing hardware

Using an OPT101 light sensor, we measured the light intensity of the light source. The outputs of the sensor were then connected to a computer interfacing system. The computer interfacing system was constructed from an amplifier, an ADC (analog to digital converter), and a microcontroller. The analog data from the sensor were converted to digital data by the ADC.

The interfacing system was then connected to a computer server where a wireless transmitter had been connected onto it. The transmitter sent the data from the sensor to a wireless receiver on the computer client. Using a client server software, the system could read data from the sensor only when a request from the client had been generated. The overview of the system is shown in fig.1.

Two softwares were programmed for the system. One software was for the AT8951 microcontroller and the other one was for the server and client computers. We used Delphi with socket programming for developing the program. The flowchart of the client server program is shown in Fig.2.

2.3. Sensor Calibration and Testing System

Light intensity sensor was calibrated by using a standard lux meter and a voltmeter to find the relation between light intensity (I) and output voltage (V). After completing all system, the telemetry was tested by using a variable light source and the signal strenght was measured by using freeware NetStumbler software.

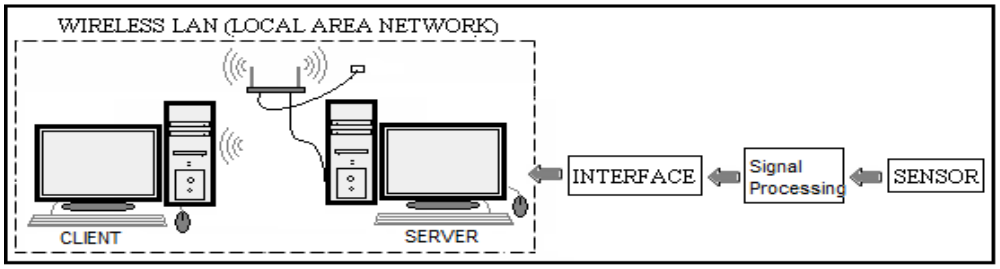

Figure 1. Intensity Measurement System using Wireless LAN

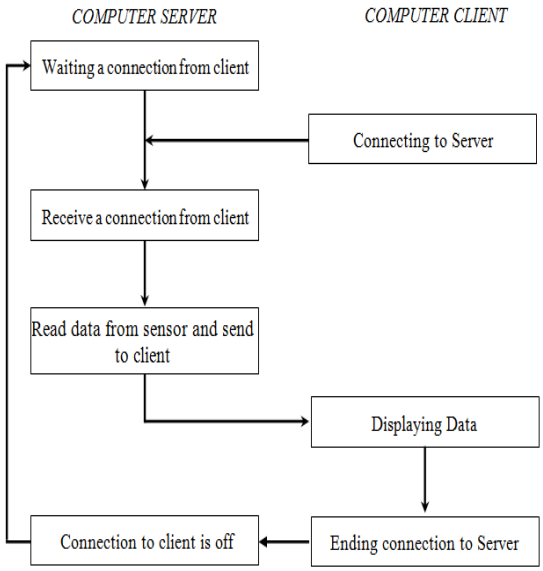

Figure 2. The flowchart of telemetry for light intensity measurement

3. Result dan Discussion

3.1 Sensor Calibration

By varying the light intensity from minimum to maximum, we found a corelation between light intensity and output voltage of the sensor as shown in fig. 3. The calibration data showed that the maximum output was 7.56 volt. By using a linear regression method, we found an equation of I = 5,6337V –4,4912 with R^2 = 0,9913, where I is light intensity and V is output voltage of sensor. R^2 indicated that the equation closely matched the graph [9].

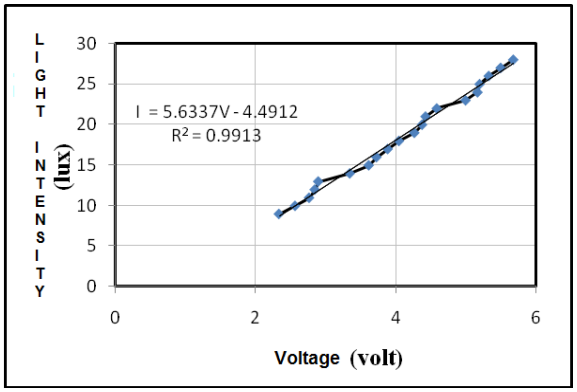

Figure 3. Light intensity versus voltage of OPT101 sensor

3.3 System testing

The wireless telemetry system was tested on varied light intensity. Firstly, the data displayed by the computer server were compared to those on the computer client from time to time. We then tested the system for light from the sorrounding. We placed a barrier on the sensor surface to prevent it from a direct exposure to light. The test showed that the voltage output increased when the light intensity increased. The display of wireless telemetry system measurements on the server and client computer were shown in fig. 4 and fig. 5, respectively.

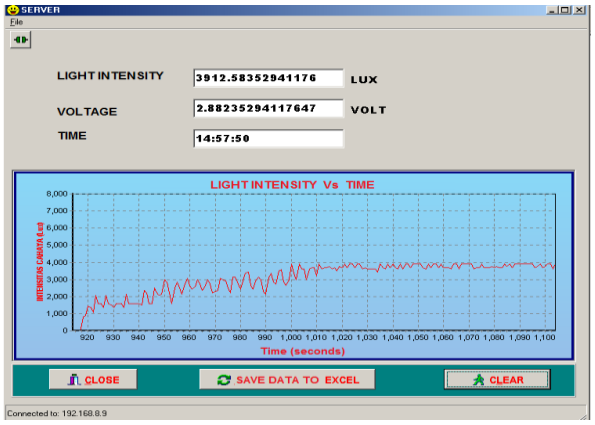

Figure 4. Display of software of wireless telemetry system on the server when reading data from the sensor

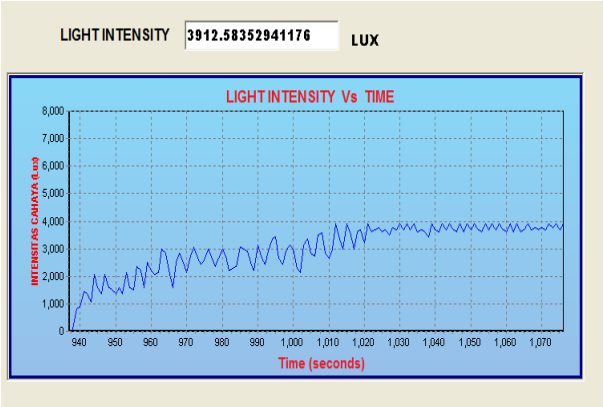

Figure 5. Display of wireless telemetry system monitor on the client when reading data from the server

3.4. Signal Strength

Signal strenght reading by client of wireless light measurement system was read by using NetStumbler software. We variated distance between client and server every 2 metres then for each distance the signal strenght was recorded. From experiment we found that the maximum distance where client still can receive signal from server is 226 m. The measurement result showed in Appendix

4. Conclusion

A telemetry system designed by using using an OPT101 sensor, a microcontroller, and a 54 Mbps, 2,4 GHz wireless LAN for measuring light intensity was successfully developed. The system could read light intensity until 226 m and the least intensity that could be read was 1 lux.

References

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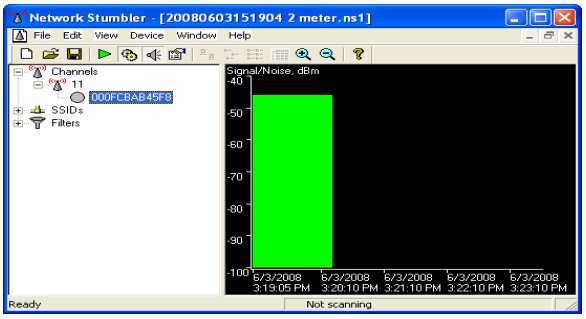
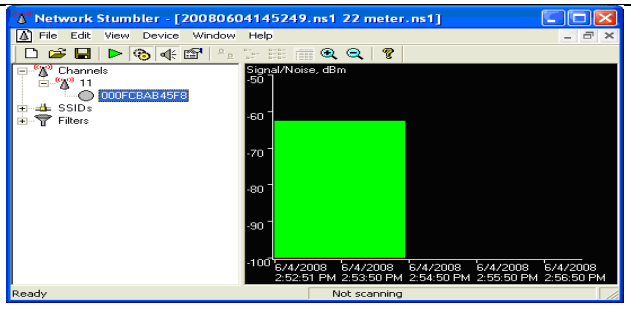
Appendix . Signal strenght of wireless reading from several distances by using Network Stumbler (NetStumbler)

No	Distance	Signal Strenght
1.	2 m	
2.	22 m	
3.	34 m