Applicaton of USB Serial Communication to Radon Measuring System

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***Abstract*—** The USB serial communication such as USB-Serial-for PC and USB-Serial-for-Android is studied in order to monitor the measure radon data using a PC screen or a smart phone screen. Through some experimental studies, we believe that the USB serial communication module is useful for checking the data transmitted to a PC from a microcontroller.

Keywords*-USB; serial communication; Android;PC;radon measuring*

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I. INTRODUCTION

Radon is a natural, inert, invisible, odorless, chemically inactive, and radioactive gas emitted by the earth. It is produced by the decay of uranium ore, such as radium, actinium, or thorium. There are many commercial instruments and techniques available for measuring radon indoors. In [1], the system is developed which monitors the radon level, using a PIN diode for detecting the radon particles and a data processing module with Wi-Fi communication capabilities for the transmission and management of measurement results. In [2], a radon counter using PIN photodiode radon sensor module was implemented. Through experimental studies, they found that the PIN photodiode sensor module could be used for a radon counter implementation. There is also much research regarding the measurement of radon concentration in soil gas, water, and indoor air. In [3], results are presented of a preliminary study of radon concentration in soil gas. For the study, AlphaGuard equipment was used to obtain samples from 64 locations within 13 urban areas in Bulgaria from 2008 to 2012.

For our experiments, we used a radon measuring system with USB serial communication. This radon measuring system was used to measure the radon concentration of indoor air in houses and workplaces.

II. RADON MEASURING SYSTEM

A radon measuring system was implemented using Arduino MCU, LCD display, PIN photodiode, plastic chamber, and low-cost ICs (Figure 1). There are a LCD module, Arduino MCU and PIN photodiode, a plastic chamber attached to PCB.

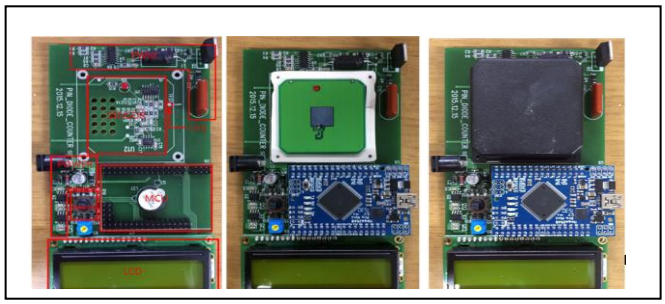

Figure 1. Implemented radon measuring system.

III. USB SERIAL COMMUNICATION

A bidirectional wire communication module was developed in order to download the measure radon data from the radon measuring system to PC. In this paper, a USB-UART serial communication method was chosen.

A. *USB-Serial-for-PC*

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started [4, 5, 6, 7].

The schematic diagram of the USB communication between a PC-USB converter and a MCU board is shown in Figure 2. The spec. of the microcontroller Atmega16U2 which is used for PC-USB conversion module is shown in Figure 3. For connecting to PC using USB cable, it is connected to COM port of PC through "USB to UART bridge" as Figure 4. The USB to UART Schematic diagram is shown in Figure 5.

B. *USB- Serial-for -Andriod*

This is the case when a smart phone is used instead of a PC. The advantage of this approach is that the PC to USB module can be developed using OTG cable and Android App. Figure 6 and Figure 7 show an Android App program and a test for Android connection, respectively.

IV. DATA TRANSMISSION TEST

Figure 8 shows that the data of main system are transmitted to a PC via USB cable and they are output on the serial monitor window. When the serial monitor window is executed on a PC and the data transmission menu of a system is run, all of the data of a system memory such as measuring time, measured radon concentration value are checked to be output on the serial monitor screen of a PC.

V. CONCLUSION

A radon measuring system was implemented using a PIN photodiode. The USB serial communication such as USB-Serial-for PC and USB-Serial-for-Android were studied in order to monitor the measure radon data using a PC screen or a

smart phone screen. Through some experimental studies, we believe that the USB serial communication module is useful for checking the data transmitted to a PC from a microcontroller.

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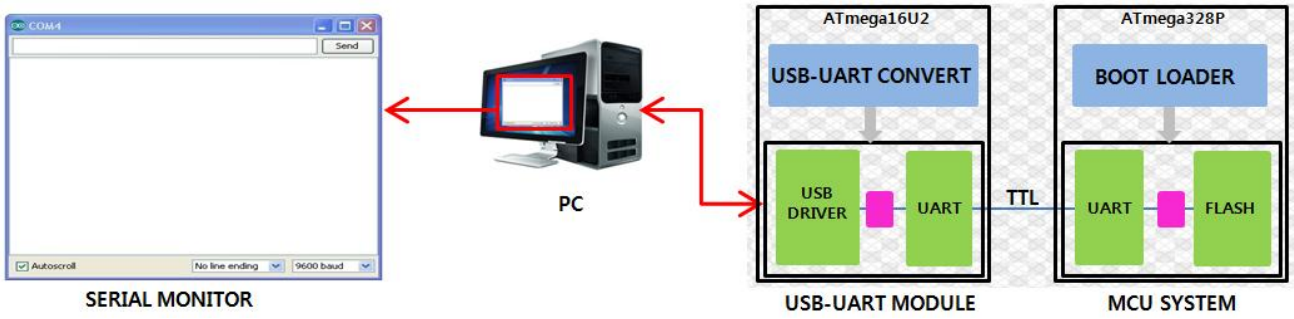

Figure 2. USB-Serial-for PC Communication

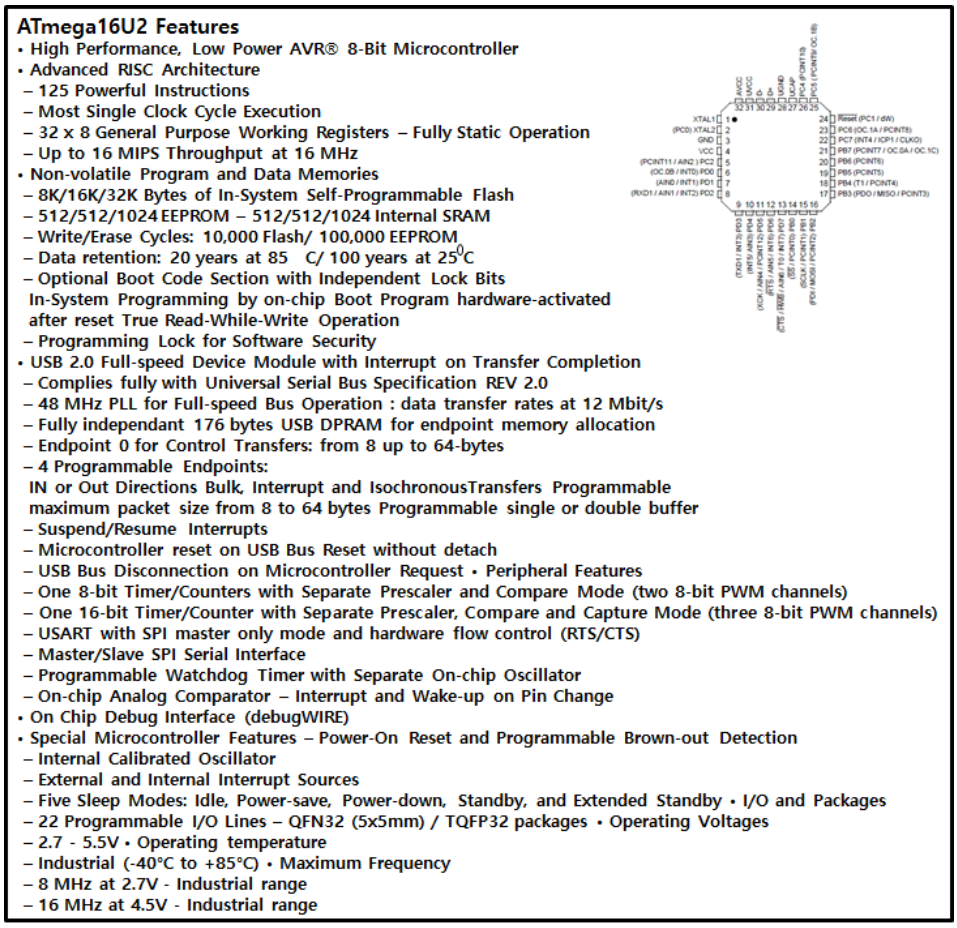

Figure 3. The spec. of the microcontroller Atmega16U2

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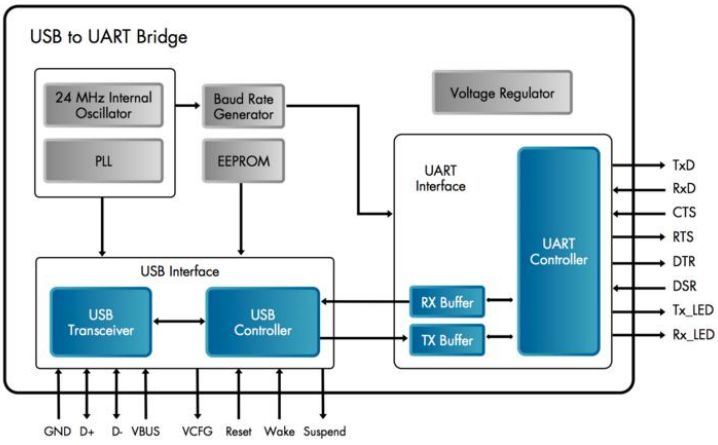

Figure 4. USB to UART bridge diagram

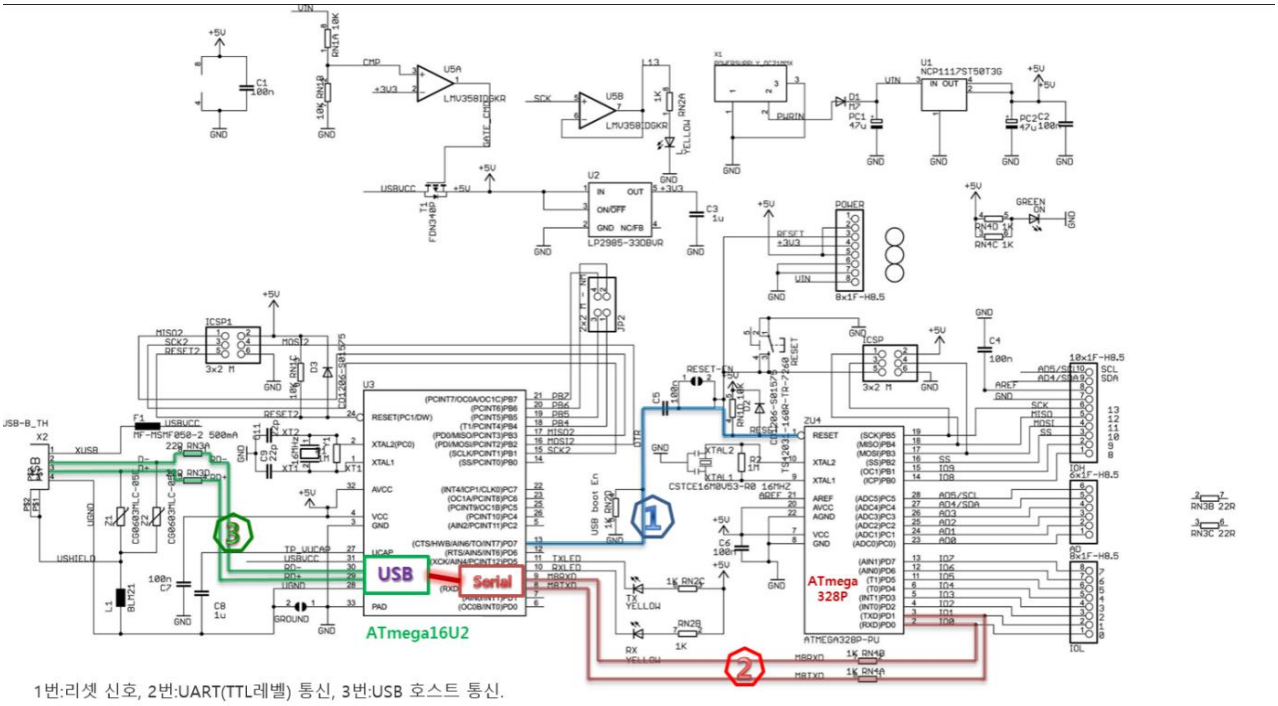

Figure 5. USB to UART schematic diagram

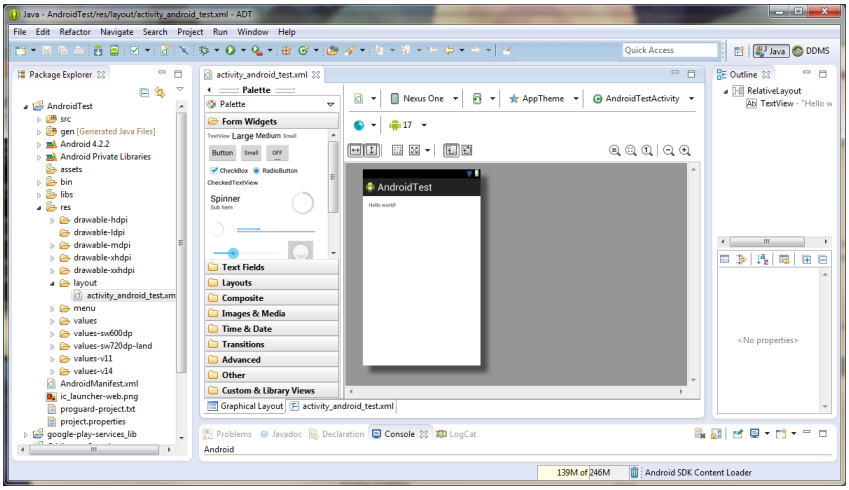

Figure 6. Android App program

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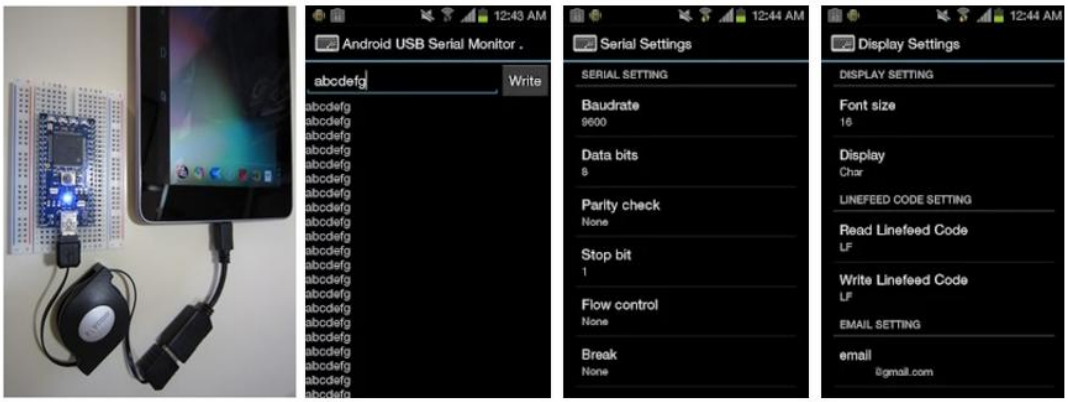

Figure 7. Test for Android connection

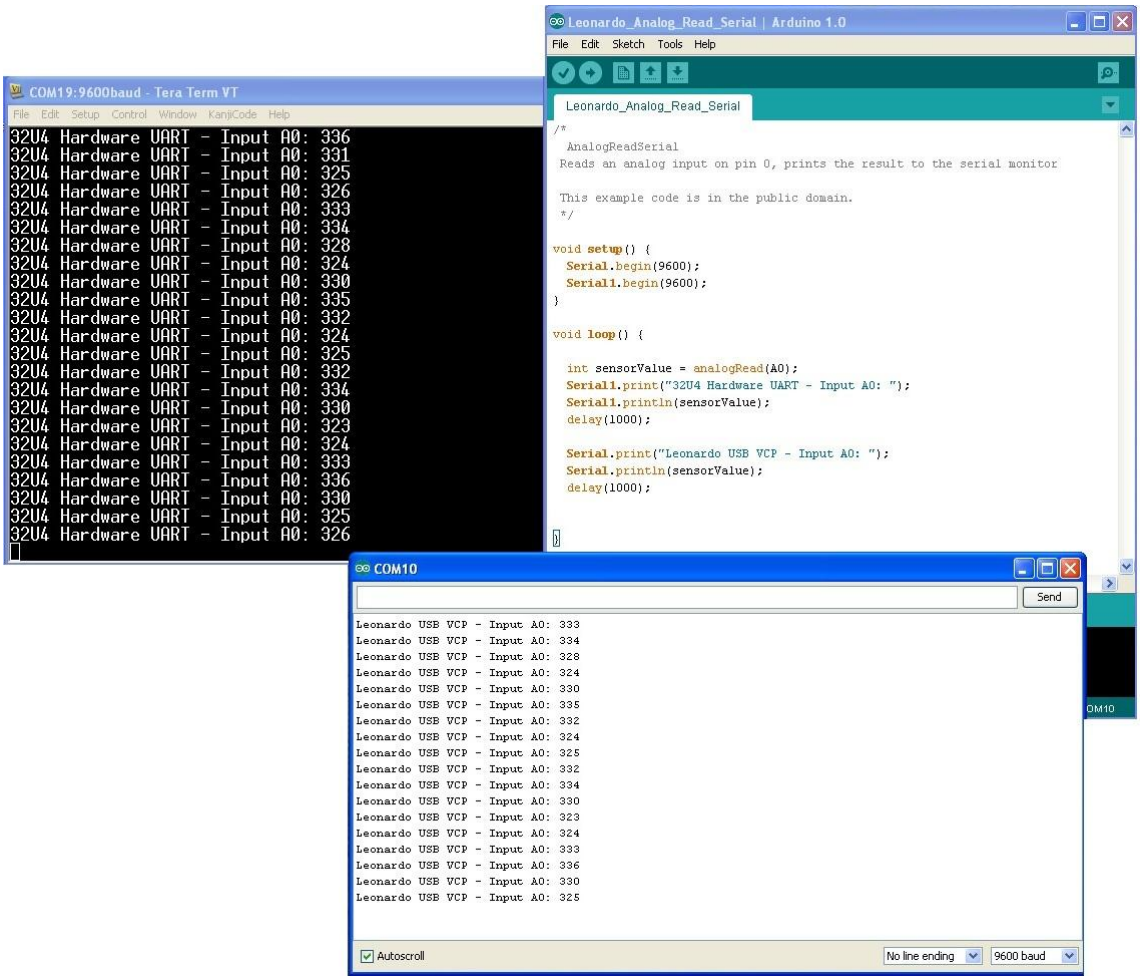

Figure 8. Data transmission test for wire communication