Development of Smartphone Application for Radon Safety Monitoring System

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ABSTRACT

When radon is staying at alveoli and bronchial tubes, the collapse of radon creates progeny nuclides (alpha ray, beta ray, gamma ray, etc.). They emit radiation causing a mutation in the chromosome of the cell, resulting in lung cancer. In other words, the main cause of lung cancer is radiation emitting as the result of radon collapse rather than radon gas. In this paper, we connected a Wi-Fi wireless communication module to the PIN photodiode radon counter and implemented the radon monitoring system using a smartphone application. As well as the output of radon data using LCDs on pin photodiode radon counters, the stored data is printed on the PC using wired communication, and the data is also displayed on a smartphone using a Widget.

KEYWORDS: radon, Wi-Fi, PIN photodiode, smartphone, Widget

I. INTRODUCTION

There are many commercial instruments and techniques available for measuring radon indoors. In [1], highly sensitive, electrostatic collection chambers using Columbia Resin 39 (CR-39) plastic track detectors were developed for measuring low-level radon. In [2], the unique characteristics and the shortcomings of track detectors for neutron and radon dosimetry is described and compared with those of alternative detector systems. In [3], low-cost alpha-particle sensor systems using special Positive Metal-Oxide Semiconductor (PMOS) transistors in a floating n-well were developed for radon and radon-daughter monitoring and dosimetry. In [4], a radon detector employed an electrically charged, pressed, porous metal filter that permitted radon-gas diffusion while blocking ambient light. It readily trapped both attached and unattached Polonium-214 (Po-214) and Polonium 218 (Po-2l8) ions present in gas passing through the filter. The filter was positively charged relative to the unbiased PN junction of a photo-diode detector within a detection chamber.

There is also much research regarding the measurement of radon concentration in soil gas, water, and indoor air. In [5], 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. In [6], measurements were taken in Transylvania, in Northwest Romania, of radon concentration in water and indoor air. The measurements were taken using a LUK-VR system for radon gas measurements, a Lucas cell for water, and CR-39 track detectors for indoor air. For our experiments, we used a radon counter with a PIN photodiode radon-sensor module [7]. These radon counters were used to measure the radon concentration of indoor air in houses and workplaces. A radon monitoring and alarm system was also used. The radon concentration data obtained from houses and workplaces was transferred using Wi-Fi and the Internet to a database on a radon-monitoring server.

In this paper, we connected a Wi-Fi wireless communication module to the PIN photodiode radon counter and implemented the radon monitoring system using a smartphone application. As well as the output of radon data using LCDs on pin photodiode radon counters, the stored data is printed on the PC using wired communication, and the data is also displayed on a smartphone using a Widget.

II. Radon Concentration Monitoring Using Smartphone Application

The measured radon concentration data during the measurement period can be viewed in real time using the smartphone application and can be created as a widget

2.1 Radon Display Using a Widget

The measured radon concentration data could be monitored and displayed using a widget as follows :

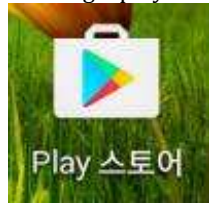1. 1st step: Enter the Google play store.

Fig.1 Google play store

2. 2nd step: Search for "thingspeak".

Fig.2 Searching for "thinkspeak"

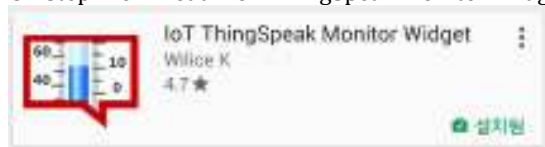3. 3rd step: Download "IoT ThingSpeak Monitor Widget".

Fig.3 Downloading of "IoT ThingSpeak Monitor Widget"

4. 4th step: Enter the Widget settings window and select "IoT ThingSpeak Monitor Widget".

Fig.4 Selecting of "IoT ThingSpeak Monitor Widget"

5. 5th step: In the configuration window that opens when you select the widget, enter the user's thingspeak channel information.

Fig.5 Entering of the user's thingspeak channel information

Once one have logged in to the thingspeak.com site, click on the channel name that one registered on "My channels" and Fig. 6 is displayed at the top.

Fig. 6 Example of channel ID

To enable the function to notify when the value of information being received exceeds a certain value, check "Upper threshold extended alert" and set "threshold value" to 148. This is because 148Bq/m^3 is the reference value for radon concentration. The ID in "second field and alert settings" is used if the user is not using multiple fields per channel.
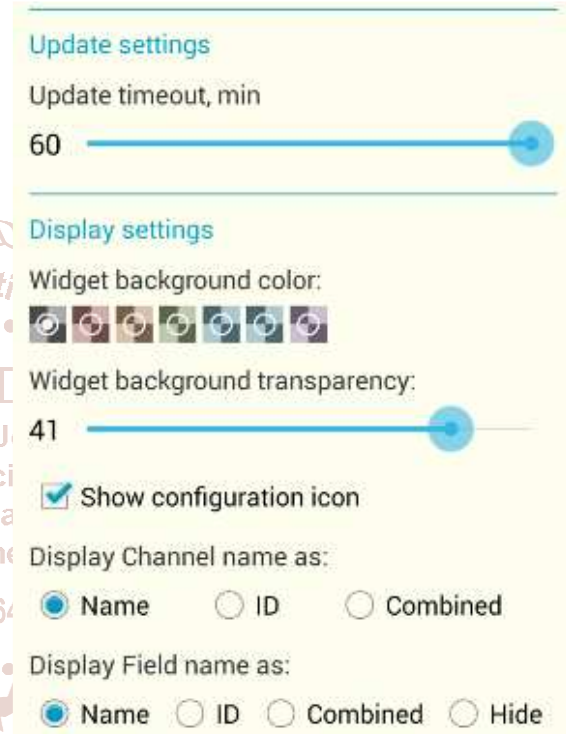

Fig. 7 Update and display setting

Since the radon concentration is updated every hour, the "update timeout" should be min 60. Other settings may be set to their default values.

6. 6th step: Finally, one can see that the widget is set up as Fig. 8. One can adjust the size of the widget.

Fig. 8 Widget setting

Fig.9 Clicking of lightning icon

7. 7th step: The radon data that is displayed as a widget is the most recently updated data, not in graph form. Click the lightning icon at the bottom of the widget of Fig. 9 to get a quick, at-a-glance.
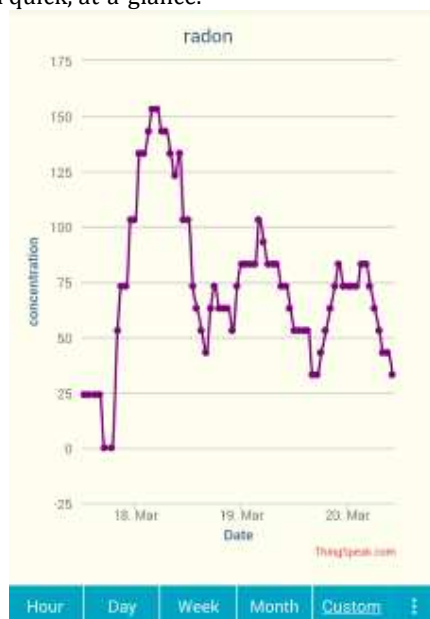

Fig.10 Radon concentration graph

The graph shown in Fig. 10 appears when one clicks the icon. Hour, Day, Week, and Month are graphically showing data up to an hour, a day, a week, and a month prior, respectively. Custom items are items that display data set by pressing the : button on the right. To view the entire data, press the : button to set Chart by to Result Count and then set the Results count to the maximum value of 8000. One does not need to touch the Rounding setting.

Fig.11 Manual update of radon data

When one sets up the widget, one sets the data to be updated once an hour and the Radon meter sends the data once an hour, so one does not need to update it manually. However, if one wants to update the data manually, one can click on the data portion of the widget.

2.2 Radon Display Using an Application Icon

The method one uses as a widget must create a widget on one's smartphone desktop. If one does not create a widget, it is not available. One can use the following method if one wants to use it like a normal application without creating a widget.
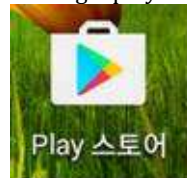
1. 1st step: Enter the Google play store.

Fig.12 Google play store

2. 2nd step: Search for "thingspeak".

Fig.13 Searching for "thinkspeak"

3. 3rd step: Download "ThingSpeak viewer".

Fig.14 Downloading of "ThingSpeak viewer"

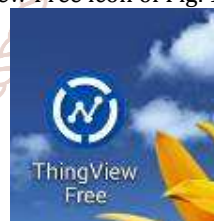Then, the ThingView Free icon of Fig. 15 will appear

Fig.15 ThingView Free icon

4. 4th step: After running the application, press the (+) button of Fig. 16.

Fig.16 ThingView (+) button

5. 5th step: In the Add new channel window, enter one's channel ID and Read API key and press the Search button. One must uncheck the Public item before one can enter the Read API key. If the user did not create a public channel when forming a channel, turn it off.

Fig.17 Add new channel

6. 6th step: Clicking on a user's channel name will show the data results recorded so far on that channel as shown in Fig. 18. If one wants to see the graph in detail, one can select it to zoom in and click on the screen to see the data as one moves the point.

Fig.18 Radon concentration graph

Fig.19 Zooming of the radon concentration graph

III. Concluding Remarks

In this paper, we connected a Wi-Fi wireless communication module to the PIN photodiode radon counter and implemented the radon monitoring system. So, we think that our developed system would be very helpful for the construction of radon concentration database and for the labor charge reduction and efficiency improvement in making the radon map of Korean government. As well as the output of radon data using LCDs on pin photodiode radon counters, the stored data is printed on the PC using wired communication, and the data is also displayed on a smartphone using a Widget. As the result, the radon concentration data could be easily checked on the screen of a smartphone.

Acknowledgment

References

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