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Monitoring Environmental Parameters through GPRS Network

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Abstract: This paper presents a data acquisition system which is used to monitor the information of the temperature and the humidity environment and to log these data to the server through GPRS (General Packet Radio Services) network. And then, users could access these data from anywhere when they go to a normal website through the internet network. Because this system is able to connect many sensors in order to collect many environmental parameters at different positions in long period, it is potential benefit for environmentalist and meteorologist of their research. Furthermore, the cost of this system is very cheap with 50 USD for one; it is very useful for the researchers in the developing countries in which Vietnam is one.

Keywords: Enviromental Parameters, Data Acquisition System, GPRS, MySQL Database.

1. Introduction

The collection of the environmental parameters always is concerned by scientist in many different branches relating to meteorology and environmental studies. This important information is used in evaluating quality of life as well as predicting any catastrophes from nature. It seems be that this work is an easy task, however, it usually takes a long time and high cost, especially when data are required to collect from different places and needed to measure for a long time.

Data acquisition or data logger is a system which could use for collecting data automatically. It is clear that by using this system, we could save lots of time and money [1-6] for collecting data, because we only need to set up this system one time and then we could view data everytime when we need.

Most types of data acquisitions are able to collect data of environment and then display them in a Light Crystal Display (LCD) [7,8] in real time. Some of them have ability to record data in their memory or in external memory card for collecting in a long period [9,10]. However, they didn't satisfy environmentalist and meteorologist because it is difficult to apply them in different places. With the

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memory option, they look more flexible, but the data is not actually real time and still need to collect data daily or weekly.

Now a day, we are in the century of mobile technology, the data network covers almost everywhere in the world. Thus, this brings us to an idea of a monitor system which could help us to measure data from everywhere in the worlds and then we could view these data through a MySQL database at any places without any special software.

2. Design of Data Acquisition System

In this paper, our data acquisition system separated into 3 main parts as shown in Fig.1 including a main controller, sensors and a GPRS module.

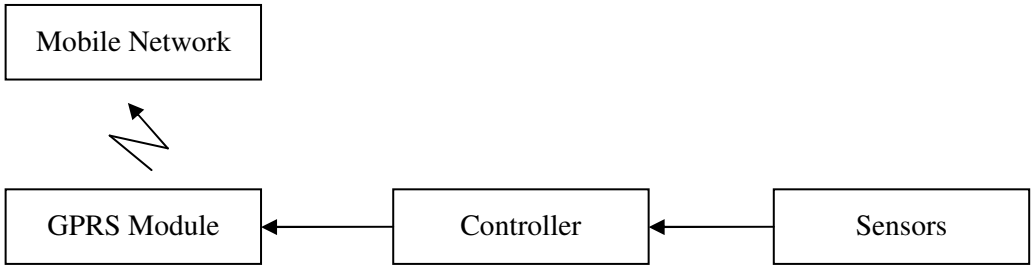

Figure 1. Structure of the data acquisition system.

The most important part of this system is the microcontroller. This part is known as the bridge which connects the sensors with the GPRS module for transmitting measured data to a server. It also controls every activity of system and defines when the data is recorded and then sent to the server. In this part, we use the STM32F103C8 chip with the high-performance ARM Cortex™-M3 32-bit RISC core operating at a 72 MHz frequency manufactured by STeclectronic (Fig. 2) [11]. Moreover, this microcontroller is easily implemented and has huge Flash and large SRAM (Random Access Memory) up to 128 Kbytes and 20 Kbytes, respectively. The large memories of this chip are required for saving data as well as network configuration.

Figure 2. Chip STM32F103C8.

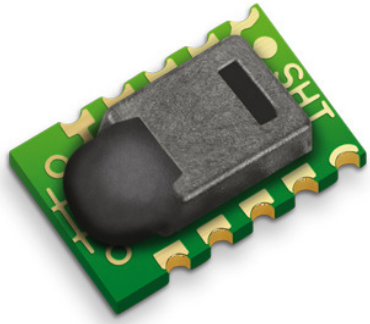

Figure 3. Sensor STH15.

A sensor block including a temperature sensor and a humidity sensor is also an important part which is used to measure temperature and humidity parameters of environment and then convert them to digital signals. After that, these digital signals will be read and recorded by the microcontroller. In our system, we use SHT15 block sensor as shown in Fig. 3. This block sensor is an IC (integrated circuit) made by Sensirion Company including both humidity and temperature sensors [12]. The operating ranges of the humidity and the temperature of this block sensor are 0 % RH – 100 % RH (Relative Humidity) and -10 °C - +55 °C, respectively. Simultaneously, the temperature accuracy and the humidity accuracy of this IC are ±0.5 °C and ±2.0 %RH, respectively. These accuracies are sufficient enough for using in the environmental purpose.

A GPRS module is the key revolution of this data acquisition system. In this system, SIM900 module is used which is a commercial GPRS module made by SIMCOM Company (Fig. 4) [13]. Thank to this module, the recorded data are able to transmit from any place to a server through the GPRS of the mobile network. Especially, this module supports TCP/IP protocol and HTTP application which are required for our system to transmit the obtained data to the server. Using this module will be presented in detail of the next section.

Figure 4. Module SIM900.

3. Logging data to MySQL database

Normally, most of mobile applications use a station computer as a server to receive data and do post-processing data at there. However, the prize for renting and maintaining a server is quite expensive. In order to solve this problem, our system send the measured data indirectly to MySQL server by sending HTTP query to a host via PhP application as shown in Fig. 5. Therefore, we only need a hosting which supports PhP application and is much cheaper than the traditional method using a server.

To do so, we have to setup HTTP command and feed the command to the GPRS module which would be done in 5 main steps (Fig. 6): Initialize the HTTP application, configure mode for query, add data to the query, terminate the query and finally wait for success.

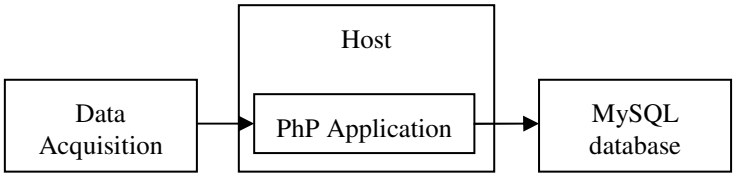

Figure 5. Solution to log data indirectly to the MySQL database

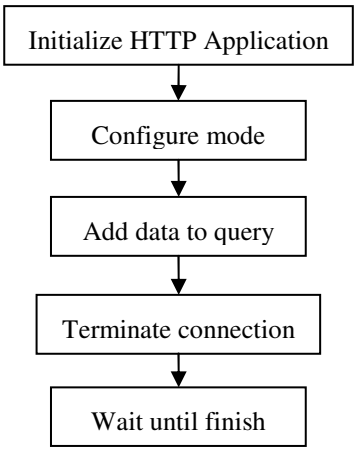

Figure 6. Command steps to send the query in GPRS module.

4. Experimental results

As described above, the data acquisition system have been designed and fabricated which could log data to the MySQL database. Our system is very compact and just fit into a small PCB board (Fig. 7) with 4.7 cm x 3.4 cm size. Although it is small, it logged successfully the obtained data to the MySQL database (Fig. 8). After that, users could choose how the data appear in a web browser by logging to the website: http://rndplus.net/test.php. A simple form of logged data was shown in the Fig. 9, these data also recheck whether the system works or not by showing the data continuously.

Figure 7. Image of our data acquisition.

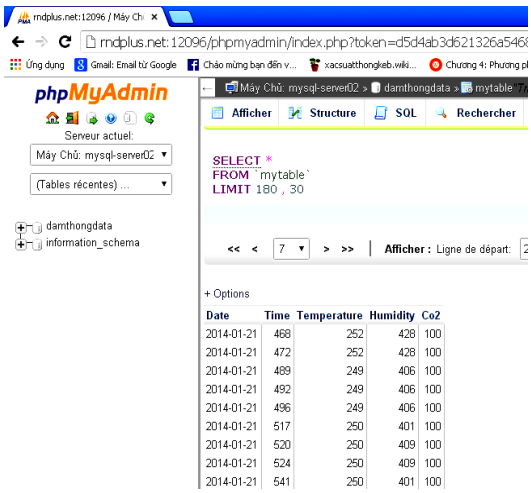

Figure 8. Data was recorded in MySQL database.

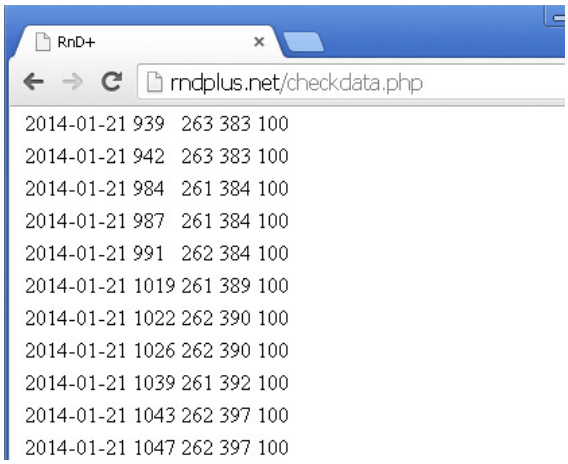

Figure 9. Measured data in web form.

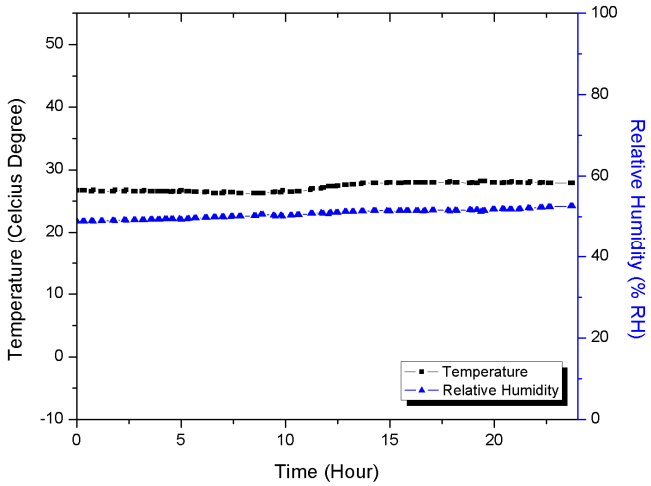

Figure 10. Temperature and Relative Humidity collected at day 22nd Jan 2014.

The curves in Fig. 10 are the measurement of temperature and relative humidity for a day of Jan 2014 in Hanoi. The temperature varies from 26.6 ^{0}C to 28.3 ^{0}C, and the relative humidity changes from 48.8 %RH to 52.7 %RH. The low humidity are agreed with the dry seasion in Hanoi. Therefore these results reconfirmed that the fabricated acquisition system is believable and stable.

Our data logger is portable and cheap. By using GPRS mobile network, it could be used in any place where mobile network is available. Additionally, this system is made from simple IC and some low cost components so its prize is around 50 USD which is much cheaper than other ones. However, it could satisfy the environmentalists and meteorologists in doing their researches.

5. Conclusion

In this study, we have successfully developed a data acquisition system which is able to log data to the MySQL database. The major environment parameters such as temperature and relative humidity were successful investigated and log to database in 24 hours. These obtained data are shown clearly the environmental characteristics at the time of the measurement. It also has advantage in mobility and price satisfied the requirement of environmentalist and meteorologist. In the future, the data acquisition system will be optimized the energy consumption for using only solar energy and then developed for monitoring other enviromental parameters.

Acknowledgments

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References

[1] M. Moghavvemi, K.E. Ng, C.Y. Soo, S.Y. Tan, A reliable and economically feasible remote sensing system for temperature and relative humidity measurement, Sensors and Actuators A: Physical, Vol. 117 (2), pp. 181-185, 2005.

[2] Kamarul Ariffin Noordin, Chow Chee Onn and Mohamad Faizal Ismail, A Low-Cost Microcontroller-based Weather Monitoring System, Chiang Mai University Journal, Vol. 5 (1), pp. 33-39, 2006.

[3] Pranita Bhosale, V.V.Dixit, “Agricon”-Weather Monitoring System and Irrigation Controller, IOSR Journal of Electronics and Communication Engineering (IOSRJECE), Vol. 1(6), pp. 5-11, 2012.

[4] Ivan Simeonov, Hristo Kilifarev, Raycho Ilarionov, Embedded system for short-term weather forecasting, International Conference on Computer Systems and Technologies,Vol. 3(B), pp. 241-246, 2006.

[5] Ján Čimo & Bernard Šiška, Design and realization of monitoring system for measuring air temperature and humidity, wind direction and speed, Journal of Environmental Engineering and Landscape Management, 14:3, 127-134, 2006.

[6] G.S. Nhivekar, R.R.Mudholker, Data logger and remote monitoring system for multiple parameter measurement applications, e -Journal of Science & Technology (e-JST), Vol. 3 (6), pp. 55-62, 2011.

[7] Supco Inc., DVTH data logger manual, Technical Specification, 2007.

[8] Dataq Instrument Inc., MT100 paperless chart recorder and data logger, Technical Specification, 2011.
[9] E+E Elektronik, HUMLOG20 Data logger for Humidity, Temperature, Air Pressure and CO2, Technical Specification, 2011.
[10] Datataker Corp., DT82EM Series 3 Data Logger, Technical specification, 2011.
[11] STMicroelectronic, STM32F103x8 and STM32F103xB datasheet, Technical specification, 2013.
[12] Sensirion, Datasheet SHT1x (SHT10, SHT11, SHT15), Technical specification, 2011.
[13] SimCom, Sim900 Hardware design, Technical specification, 2009.