

Development of Weather Condition Observation System for Wind Turbine Based on Integrated Sensor Module Gateway

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Abstract: In recently, the research for offshore wind power has been activated, and many offshore wind farms have already been built. But the offshore wind turbine in a bad environment that can reduce the length of life. In order to solve these problems, the information on the offshore meteorological environment should be analyzed to provide the responses to the appropriate maintenance. We proposed a method of integration of the sensor gateway to monitor the meteorological information. Firstly, we designed the sensor modules to collect the meteorological information data and next, an integration gateway was designed to obtain the data from sensor modules and to transmit the data to central monitoring system.

Keywords: Wind Turbine, Meteorological Environment, Sensor Module, Integration of Gateway, Central Monitoring System.

1 Introduction

There have been many researches of meteorological technology active investigating based on sensor networks for forest fire prevention [1], wind farm [2], environmental monitoring [3], and information on device status measurement [4]. For the accurate meteorological measurement, it is necessary to develop the sensors.

A wind speed & direction sensor, most of them does not meet the standard of meteorological sensors (2011.1.3 Revision). As the wind speed, the technical part which requires precision does not be able to overcome the limits of error rate.

The gateway technology [5] is necessary to collect the data from heterogeneous sensor modules and to supply the data for a variety of fields. In Korea, there were some devices have been developed as a gateway type to integrate partial sensors. Thus, in order to be applied for a special field, they were supplied as costliness products according to a different communication and specification standard. In addition, each sensor's maintenance and technical service should be supported from manufacturer of them.

In this paper, in order to resolve the problem that each product consists of several sensors and they could not be exchanged, each meteorological sensor was developed

and designed as a modular. It is a device, replacement of which is easier and application and expansion of more environmental sensors for which is easier. The designed meteorological measurement system which has interchangeable modular sensors can be used as meteorological device. It is possible to take advantage of meteorological service and systems fields. In addition, the meteorological measurement system as an increasingly important system which for collecting the basis data applied to meteorological information, finance insurance, and meteorological R&D and so on.

1.1 Sensor Modules Design

The sensor modules developed in this paper include temperature & humidity sensor, CO sensor module and wind direction & a velocity sensor module.

The temperature & humidity sensor, we used SHT20 sensor made in SENSIRION Company. It has high productivity and characteristics suitable for price-sensitive applications. For the CO sensor, we used a semiconductor-type. It is more readily and need low cost compared with the NDIR type. Whose input voltage: DC $5V \pm 1\%$; power consumption: 480mW or less; output: 0.5~5V; relay output: 4V or more. The MLX90316 sensor made in Melexis Company was applied to the wind direction sensor module. It's specifications are Temperature Suffix: K(-40°C to +125°C); Package Code: DC(SOIC-8); 12-Bit D/A converter analog output voltage; a PWM signal configured with a programmable output(low signal, the high signal, the push-pull signal); a PWM signal exports 100~1000Hz programmable frequency; digital transmission content protocol (14-bit signal diagnostics available). Wind speed sensor module adopts non-contact reflective photo interrupt driven (detection) type. In addition, in order to get the accurate measure of the wind power, the wind direction & velocity measurement sensor module should be designed structurally separate from other environmental sensor modules to avoid their impact.

1.2 Integrated Gateway

The Meteorological observation system is an integrated system, where in the data collected by meteorological sensor modules and provided to central monitoring system. We can use check the offshore meteorological condition via the meteorological information from this system in real time. As for receiving and transfer the data of sensor modules, the control (Trigger) signal was applied in our proposed design. By this control signal, the system analyzes the receiving protocol of sensor modules to select the receiving sensor module (get protocol ID) and receive the collected data itself exactly. The data collected by sensor modules would be transmitted to central monitoring system by TCP/IP communication and be processed. The sensor input port of sensor gateway was designed to 8 ports. So, 8 sensor modules can be connected to the gateway. Each sensor module was controlled by a trigger signal in sensor gateway.

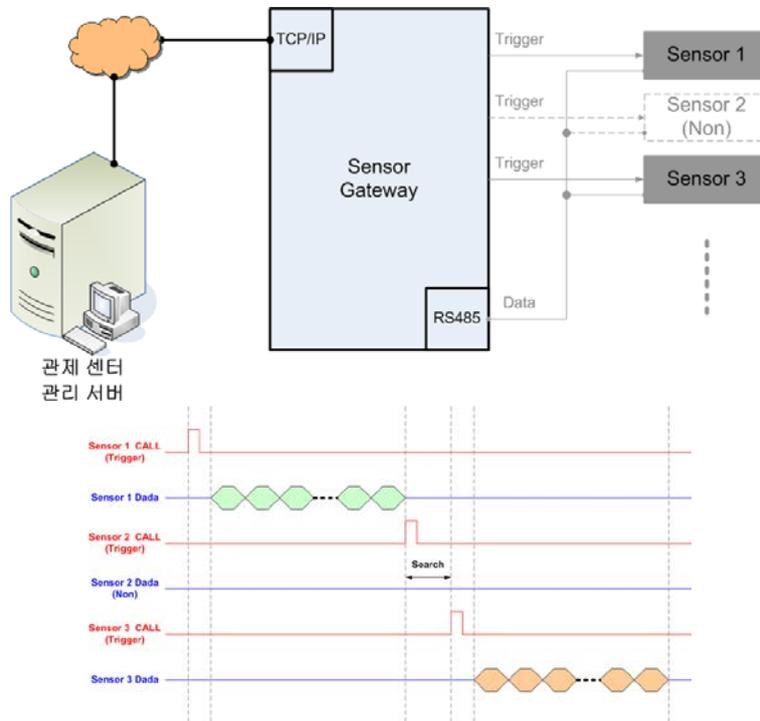


Fig. 1. The Interface of the sensor modules and timing chart of receiving and calling

2 Protocol for Sensor Module Gateway

It is necessary that the gateway should be developed to receive or call the collected data from sensor modules based on a transmission protocol.

Example of a transmission protocol format of sensor modules

#	T	M	,	0	2	3	.	5	0	E	<CR>	<LF>
---	---	---	---	---	---	---	---	---	---	---	------	------

Start	Sensor ID	,	Sensor Data	End	Carriage Return	Line Feed
(1)	(2)	(1)	(6)	(1)	(1)	(1)

Protocol configuration between the integration of meteorological equipment and sensor modules: RS485, 8 Bytes, 1 Stop Bit, No Parity Bit
 Baud rate: 19200 bps

This protocol can be operated by RS485, and use 8 bytes. Among them, one is a stop bit and not has parity bits. In this protocol, '#' means start coding; TM means Temperature. If these bits get TM, it means that the gateway will select the temperature sensor, and the sensor data show temperature values (-20.0 ~ 120.0 °C). If these bits get HU, it means that the humidity sensor selected, WD mean that the wind direction sensor selected, and WS means that wind speed sensor selected. The Sensor data bit which uses 6 bits show collected data from the selected sensor module. The E bit means end of data. CR bit means carriage return, and LF means line feed.

3 Conclusion

This paper tries to design the sensor modules (such as temperature, humidity, wind direction and wind speed sensor module), integration gateway and protocol of the gateway. The sensor module was designed for that it will be used to observe the meteorological information for offshore wind farms and other industries. Based on the observed data, the maintenance and the control of the wind turbine would be operated and the gateway will transmit the data collected the sensor modules to the central monitoring system. For transmitting the data and transmit the collected data.

In order to apply a variety of industrial fields, miniaturization of the system and the specification of the battery would have to be considered and to expect strengthening a further future research.

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