Monitoring of Wind Flow to Determine Wind Potential And Location of Wind Farms

Ostap Pashuk

Security of Information Technologies Department,
Lviv Polytechnic National University, UKRAINE, Lviv,
S. Bandery street 12, E-mail: pashuk.ostap@gmail.com

Abstract – This paper presents the results of measurements of wind flows in real time. The results can be used in energy-saving technologies, namely to determine the correct location of wind energy turbines in different climatic regions specifics.

Key words – energy , wind potential , wind turbine generator , GPRS

I. Introduction

At present, the development of alternative energy was a question of choice of effective platforms for installing wind power stations. Generation of energy efficiency and correctness of the location of wind turbines are determined by various inefficient methods [1; 2]. We have developed a computer system for monitoring wind flows (CSMWF), which was used to determine the speed and direction of wind flow in real-time transmission and processing of data for further analysis and determination of wind potential and assess the feasibility of building wind power plants (WPP) and select the turbines type (Wind Turbine Generator, WTG), effective for installation in a given area. In this system, a system of protection against unauthorized removal or damage meteostations is provided. Data transfer is carried out every minute using GSM network that enables real-time calculation of the predicted output energy and it also enables to track efficiently the possible failures of the equipment and to detect tampering. This paper presents the results of measurements of the characteristics of wind flow carried by the given system, and theoretical calculations of predicted output energy.

II. Meteoposts and Measurement Techniques Description

The The method for data input is the location of the sensor, anemometer and wind vane at a height of 27 meters, due to a lower point of the wheel of a wind turbine generator at a given altitude and the data transfer to the server. The device for automatic electronic registration of wind features and data to the server (meteostation) consists of anemometer and Davis wind vane (Davis Instruments Corp. U.S.), as well as control and transmission unit, temperature sensors and security sensor. The control unit is implemented on a RISK AtMEGA16U microprocessor and module data transfer technology GPRS (SIM900). Data on the server is carried out using GET HTTP. Power supply is independent, implemented on impulse power adapter using voltage 6 - 48V - 5V so you can use 18A 12V battery and it provides the device working for 25 days; the optional lithium- ion battery 3.7V 1500 is used to provide emergency power supply for three days and battery monitoring is included. The equipment is mounted on a telescopic type tower.

The server component is implemented using a set of OS UNIX open source software (Open-source software), MySQL database, Apache HTTP- server, PHP, Perl and HP ProLiant ML110 G7 hardware.

The data from meteoposts are processed and stored in Table 1 for further visualization in speed graphs and wind direction in Fig. 1, Fig. 2 and a wind rose construction in Fig. 3 to determine the correct location of the WTG. The developed software module interface with WindPRO software (EMD International A / S. Denmark) allows analyzing the findings and sending WindPRO Online Data for building global and regional maps of winds.

III. Experimental Part

Table 1 shows the experimental data obtained from sensors located on the weather station.

TABLE 1

EXPERIMENTAL DATA FROM METEOPOSTS

ID	DATA	TIME	WIND	MID	LWIND	DIR	TEMP	TEMP2	alarm
86818	2011-10-16	00:00:45	2.27	2.14	1.95	NNE	2.44	-1.06	0
86819	2011-10-16	00:01:47	2.27	2.1	2.06	NNE	2.44	-1.06	0
86820	2011-10-16	00:02:50	2.27	2.12	1.84	N	2.5	-1	0
86821	2011-10-16	00:03:52	2.49	2.32	2.27	NNE	2.44	-1	0
86822	2011-10-16	00:04:54	2.49	2.34	2.27	NNE	2.44	-0.94	0
86823	2011-10-16	00:05:56	2.06	1.88	1.5	NNE	2.44	-1	0
86824	2011-10-16	00:06:58	2.16	1.7	1.39	NNE	2.44	-1.12	0

where : ID - identification number of the record, DATA - recording date , TIME recording , WIND - maximum wind speed (m/s) within a minute , MID - average wind speed (m/s) within a minute, LWIND - minimum wind speed (m/s) within a minute, TEMP - temperature control unit container (C), TEMP2 - outside temperature (C), alarm - alarm condition on a weather station.

The visual presentation of the data was carried out using cacti (Figs. 1 and 2).

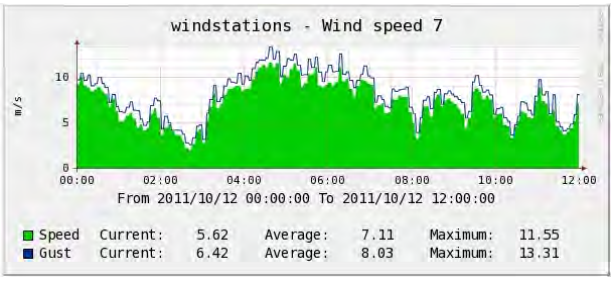

Fig. 1. Visualization of changes of wind speed

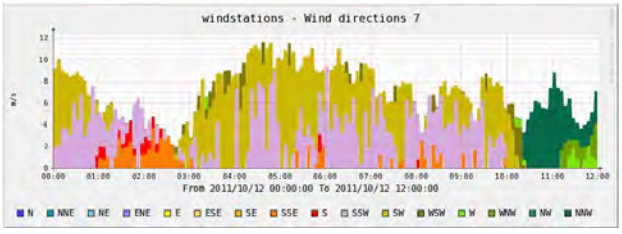

Fig. 2 Spectral changes of wind directions

Spectra give an idea of wind energy to the area, which further makes it possible to calculate the forecasted output power.

According to the spectra (Figs. 1 and 2) a wind rose (Fig. 3) was constructed.

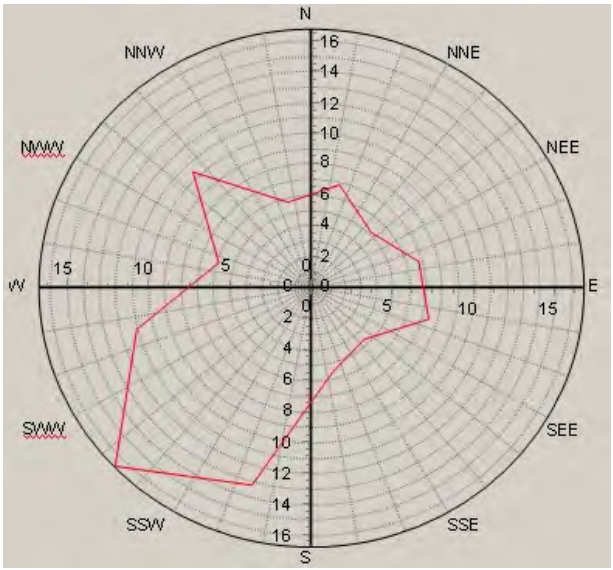

Fig. 3 Windrose

This wind rose is used to determine the correct location of WTG and take a decision of choosing the turbines types. As shown in Fig. 3, the SWW and SSW winds predominant. Generators should be located perpendicularly to the direction of the winds, so as not to overshadow each other.

Conclusion

Assessment of performance of wind farms suggests the presence of wind potential at the site of the proposed wind farm during the installation. As a result of wind roses we can make a preliminary conclusion about the feasibility of building WPS based on WTG on this platform upon the condition of perpendicular position of generators to the vector of prevailing wind direction for the area and calculate the estimated power output.

References

[1] Posudin Y. Methods for measuring environmental parameters . - K. : World , 2003.

[2] Dataloggers & Monitoring Systems [Electronic resource] – Mode of excess : http://www.ekopower.nl/