DATA ACQUISITION SYSTEM AND REMOTE MONITORING BASED IN CELLULAR NETWORK FOR MANAGMENT OF BRAKE PAD WASTE AND WIND POWER TOWER VIBRATION.

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Abstract

This abstract shows a low price data system acquisition developed at UFRGS and SATC faculty labs specially to monitor the waste of brake pads and the vibration sensor of small wind powers. The paper presents an acquisition data interface using cellular phone for transmission and reception of monitoring remote data. The objective of this paper develops a prototype of a data system transmission and reception for variable monitoring in wind power using the cellular network.

Key Words: Wind Power, Acquisition, Remote Monitoring, Cellular Networks, System Communication.

0. Introduction

Today, more and more data transmission becomes an essential tool for many kinds of sectors. The economical development and the high technology of the actual days bring us the necessity of an instantaneous communication, becoming as strategy our survival in the marketing where the simultaneous communication will be decisive to conquer new clients, Gasparini et al. [1]. Wireless transmission systems do not use cables or wires and use electromagnetic waves as the propagation medium for communication between two points or devices. The term is usually employed in the telecommunications industry to define the distance communication systems (eg, radio transmitters and receivers, remote controls, computer networks), that use some form of electromagnetic energy (radio waves, infrared light, laser, sound waves etc) to transfer information without wires, Dorman [2] .

To become renewal energy system available, we need these systems be self-sufficient or that they need the minimum of repair. Remote system monitoring does this job, doing distance management of one or more wind power unit, for example. The reduction of unnecessary visit of maintenance employee is already a big advantage to carry out the remote monitoring. For the remote monitoring exist today many kinds of technology used, however the use of communication canal still being a dilemma for many people, Fiorese. [3]. The use of renewable energy, such as wind generation, it is increasingly evident. The reduction of CO_2 emissions has been seeking by conscious countries and conscious energy revolution can be a reality, Greenpeace 2008 [4], increasing comfort of our day to day, with minimal consumption of energy and clean energy. The small wind power needs to brake its movements periodically to avoid maintenance that could come and when the charge battery finishes, Lutz [5]. The disc brake system has a brake pad wearing on usage. Monitoring the wear of brake pads is an important factor to be controlled. The expenses with visits of technicians to evaluate the waste is prohibited, so the remote monitoring is the proposed solution.

1. Motivation

The wind generation systems are to a large expansion, according to the Global Wind Energy Council (GWEC) figure 01, WWEA and Eletrobrás are representative associations this market. The demand for this technology is growing at large steps above the average expected inclusive, many manufacturers have a time delivery of the order of two years or more, Qiao and Sawyer. [6]

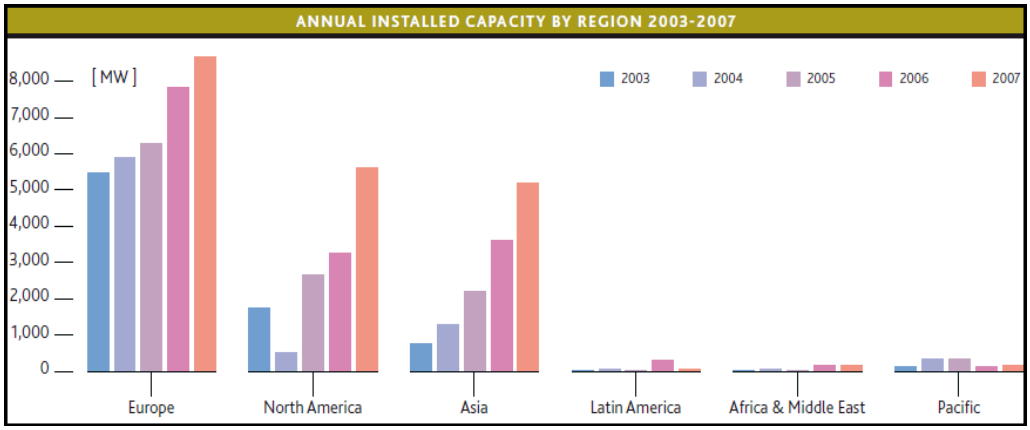

Figure 1 – Annual installed capacity by region 2003-2007
Source: GlobalWindEnergyCouncil(GWEC)

According global wind 2008 report despite economic downturn, The 2009 industry forecast predicts that the word's wind energy capacity will nearly triple in the next five years, following a decade of spectacular growth. GWEC predicts that in 2013, five years from now, global wind generating capacity will stand at 332 GW, up from 120 GW at the end of 2008. The year-on-year growth rates during this period will average 22%, which is modest compared to an average increase of 28% over the last ten years.

These systems increasingly need to monitor, the installation is usually in remote places that are far from technological resources, Lee [7]. As these systems require little maintenance, is not justifiable that a person is on site to do any maintenance. The problem is how to send signals to remote locations without minimum infrastructure required to data transmission.

The communication from remote areas with a central of information is one of the advantages of wireless transmission. Transmit data without the need for cables connecting between transmitter and receiver becomes a great advantage for such applications.

The best way to data transfer is by radio frequency, which for this application was set as follows: A board of acquisition signals capture data from sensors and passed to the radio transmitter, that in turn transmits to the receptor, which is some distance from the wind power, where data is collected and monitored through a system of data analysis.

2. Methodology of application of remote monitoring using wireless technology

The methodology presented below is for various applications, but to demonstrate the operation was used a system of small wind generation. This system has a sensor of vibration in the tower that with existence of strong winds send a message to central. Winds above the standard can damage the wind powers and maintenance is necessary, Lehmann and Koenemann [8]. Another sensor is the one used to monitor brake pad waste, small wind power needs to brake its system sometimes in its useful life. The problem is in defining the moment of changing the brake pad, hence a system of sensors were installed to indicate the level of waste from pads. For this study the sensor of vibration of the tower and sensor of brake pad waste were the variables to be transmitted and monitored the distance. Figure 2 shows the structure of the application used.

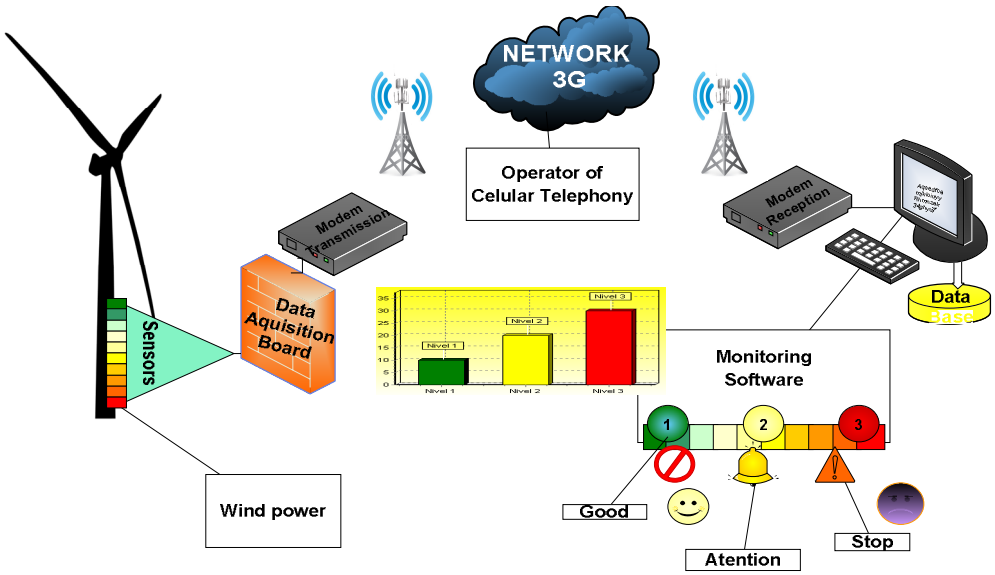

Figure 2 – Diagram of the variables monitoring solution in wind power.

What make up a system of wireless communication - Wireless for monitoring to the distance: The system for remote monitoring by wireless transmission network - Wireless base is composed of five key elements of the process:

A. Intelligent Machines and Sensors

Devices that monitor, control and measure any type of activity locally. It maybe can existe multiple sensors in a particular location, (signal acquisition board, Programmable Logic Controller - PLC, others).

B. Interface Application

Interface between sensors and communication network. For remote applications, refers to the Remote Terminal Unit (Remote Terminal Unit-RTU).

C. Basis for Communication (Backbone)

The system can be fixed lines or by radio, and transmit information from sensors through the application interface to a computer and a central command center of control.

D. Command and Control Center

This is the central point which receives the data transmitted bys sensors.

E. Wireless Communication Networks

The communication network is the physical structure that provides the connection between the remote terminal unit and central control, can operate by wireless or physical communication.

3. Evaluations Model

A. Wind power

This is a device with a generator to convert wind energy[1] into electric energy, figure 03, or else, a wind turbine that actuates an electric energy generator. This type of generator has quickly become popular because wind energy is renewable, different from burning fossil fuel. It is also considered "clean energy" (environment-friendly), since it does not require combustion which will produce polluting residues, nor the destruction of natural resources, Muller [9].

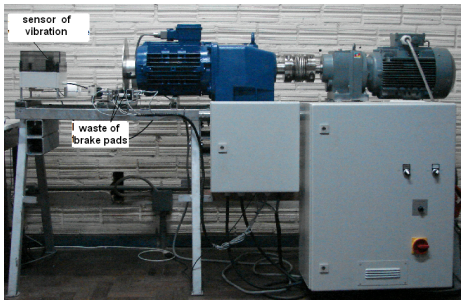

Figure 3 – Wind power side of.

B. Data acquisition system

To acquire two variables in wind powers (sensor of vibration of the tower and the brake pad waste) was developed a special data acquisition, figure 4. This board consisted of dedicated microprocessor and peripherals. This acquisition system is monitoring the sensors and when an usual sign appears the electronic system triggers remote access connecting to the wireless network and transmitting data.

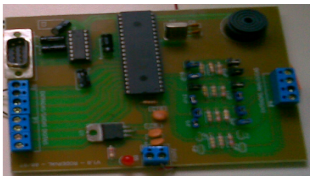

Figure 4 – Data acquisition board.

[1] The use of wind energy consists of converting the kinetic energy of a mass of moving air into mechanical energy. This is generated by rotation of the vanes around an axis which, through an electric generator, converts it into electric energy.

C. System for transmission of signals

The structure mounted is a transmitter and a receiver (wireless modem, figure 5), where through a communication way called Celullar GPRS/3G network, the network transmit and receive signals to the Remote Monitoring System.

Figure 5 – Cellular Modem Communication

D. System Monitoring

The monitoring system developed is based on a cellular modem, which receives the signals from the system-board electronics. Software in a high-level language serially receives the signals from the modem and processes them. This processing means to evaluate the values of the sensors and determine the best action to be taken. As an example the case of vibration sensor is indicating excessive vibration in the tower of wind power, an alarm appears on the screen indicating the problem of the system. Thus the operator may take the best action. The figure 6 shows the studied proposal.

Figure 6 – GPRS/3G Cellular Modem Communication

4. Obtaining the distance data

To study the various tests were simulated for transmission and reception of the variables. Figure 7 shows the simulated test data received from the vibration of the wind power.

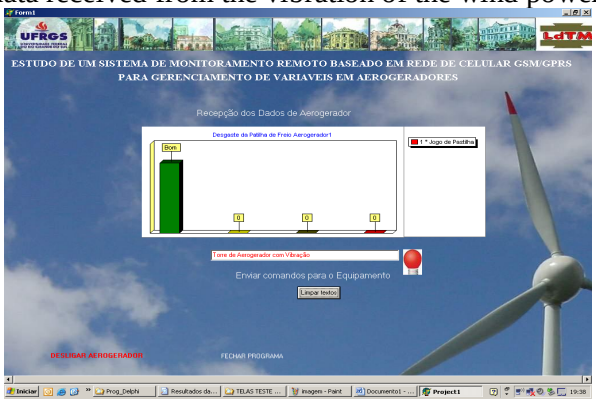

Figure 7 – Screen wind power receiving data with vibration (light red), appearing for the operator concerning simulation of vibration of the tower wind power.

The figure 8 receives test data from the simulated transmission and reception of data from wear of brake pad with the wear of the first game of gum LEVEL STOP option. The system at this level can send a command to disable / turn off the wind power automatically without intervention by the system operator.

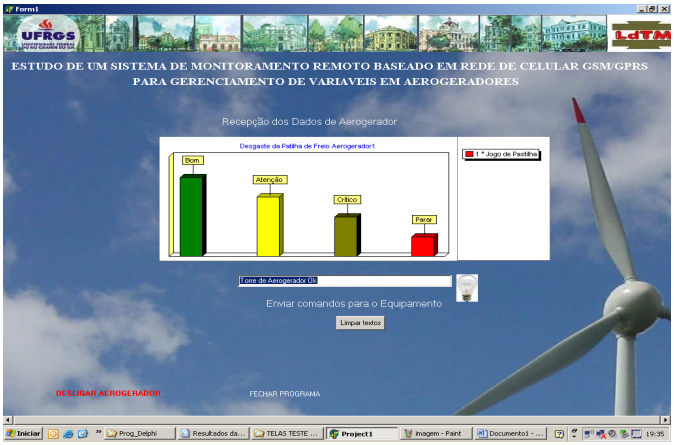

Figure 8 – Screen wear of brake pad, option STOP LEVEL

5. RESULTS

It is evident that the telemetry represents economy (reduction of expenses) for the measurement, because in the distance we can control equipments and devices.

The cellular network is reliable and safe, but it is not recommended to rigid applications. With the system, just the reduction of the technicians' trips (3 to 5 trips) was enough to save the investments that estimated in U$ 1.000,00.

Study on wind power Remote Monitoring Systems by a transmission network Wireless will bring greater control on use of wind powers installed worldwide.

Through a wireless transmission network will reduce costs of investment in a possible deployment to remote locations, and knowing that most wind powers equipment are installed in locations where a cable transmission system would be very difficult, due cost of deployment, maintenance among others.

As the model of price impact for solution, the most crucial is the fixed monthly cost for connection. Much as some providers offer solutions to a composition of fixed and variable costs, it is suggested a simplified model with only a fixed cost per point connected. This suggestion is because the trend of the transmissions of data are predictable and sporadic, so that models of simple price is taking more market acceptance. Exceptions should be made in the case of applications where there is greater complexity and volume of information exchanged in these cases the model fixed / variable still makes more sense.

An important factor to consider is the frequency with which each application uses the network as well as the laws of each country.

6. CONCLUSIONS

The majority of equipments installed in places where a transmition system by cable could be a big problem because the authorization to install it, the maintenance expenses, between others, we could use the wireless transmition network. Based in a cellular network, the reduction of expenses in investments in a possible implementation becomes evident and technically excellent. The reduction of expenses happens because the cellular network is already installed and all the maintenance is responsibility of the cellular company chosen. The tested system presented efficiency, mainly because the low quantity of transmitted and received data (KB) and the quality of cellular signal is satisfactory in the tested place.

Traditionally, various media have been used to support the applications of remote monitoring, including microwave systems, private radio, telephone lines, power network, satellite systems and network owners. The choice of a specific communication network is mainly a function of range, price of the solution and equipment, reliability of the solution, and ease of integration. The importance given to each factor depends on the need in question.

In this application, it is clear the advantages of using a monitoring system to detect the need for sending a signal to a central that only when absolutely necessary to send a special person to maintenance.

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