PC Based Wireless Wind Data Analyser

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Abstract: **This paper presents the development and implementation of a wireless wind data analyser. The proposed analyser employs the Global System for Mobile technology to read and transmit the wind data to a PC located at the work place. The output of anemometer is processed by microcontroller and transmitted to a personal computer via dedicated transmitter-receiver mobiles. The receiver mobile is interfaced to a personal computer, where the received wind data is analyzed to assess the wind potential, annual energy yield and siting. Two cup type anemometers, set up at different heights, are used for testing the proposed wind monitoring system. The output is compared with the wind data recorded using NRG wind data logger. The results are accurate. The proposed data logger can be effectively used for recording wind data from remote places.**

I INTRODUCTION

Research has shown that employing effective statistical tools for wind data analysis helps in optimum site matching of wind turbines [1-4]. It has been established that use of cubic mean cube root of wind velocities gives better estimate of power in the wind [1]. Hence, accurate measurement of wind data is an essential requirement and is done using wind data loggers. Existing wind data loggers store the arithmetic mean of wind velocities recorded over a period of time in a dedicated memory card. It requires replacing memory card at frequent intervals, which is tedious and is prone to data loss. Hence there is a need to overcome the said drawbacks of the conventional method of wind data recording.

This paper presents the development and implementation of a wireless wind data analyser. The proposed analyser employs the Global System for Mobile technology (GSM) to read and transmit the wind data to a PC located at the work place. The output of anemometer is processed by microcontroller and transmitted to a personal computer via dedicated transmitter-receiver mobiles. Two cup type anemometers, set up at different heights, are used for testing the proposed wind monitoring system. The output of cup type anemometer is a low sine wave with its frequency proportional to wind speed. This signal is converted into pulses by schimt trigger circuit. A frequency counter counts the pulses every 30 seconds. The output of frequency counter is given to a microcontroller AT89S8252, where these pulses are stored. After every fifteen minutes these are transmitted to a remote personal computer through wireless transmission mode using GSM module. The receiver mobile transfers the pulse count to a personal computer. The data is further analyzed to assess the wind potential, annual energy yield and optimum site matching. Comparing with the wind data measured using NRG wind data logger validates the accuracy of the data recorded using the proposed system.

II METHODOLOGY OF SYSTEM DEVELOPMENT

The overall architecture of the proposed wind monitoring system is as shown in Fig.1. The system has two major components, viz, Remote Transmitter Module attached to the Cup type anemometers and the Receiving Module interfaced to the personal computer. Dedicated interactive software is developed to manage the wind database. The Graphical User Interface (GUI) facilitates the user to view the wind data and the results.

Fig.1 Block diagram of Wind Monitoring System.

III DESCRIPTION OF HARDWARE DEVELOPMENT

*1) Transimitter Section:*The system hardware is divided into three modules as shown in Fig.1, the interface card at the remote transmitter side, the PC at the receiving side and the GSM modem/user mobile phone modules. The remote transmitter module is used to acquire, process, transmit the parameters to the GSM modem. A PC-based server, located at the receiver side is connected to the GSM modem, which receives SMS from the remote transmitter side, via the GSM network. The GSM module/user mobile phone module is the link between the remote module and the public GSM networks. A functional block diagram of the transmitter module is shown in Fig.2.

The frequency is measured using microcontroller (AT89C2051). Two separate microcontrollers are used for two anemometers and outputs of these anemometers are converted to square wave by Schmitt trigger. The output of Schmitt trigger is given to microcontrollers (AT89C2051). The pulses generated by Schmitt trigger are counted. The frequency is

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counted every 30-second and transmitted through port-1 of AT89C2051 to port-1 of microcontroller AT89S8252. In order to differentiate the two readings, chip select pin is used. Microcontroller AT 89S8252 is the main controlling unit. It takes the measured frequency every 30 seconds and stores in separate registers. After 15 minutes microcontroller AT89S8252 transmits the stored data to GSM module serially through RXD and acknowledgement is given by GSM to microcontroller through TXD pin.

Fig.2 Block diagram of transmitter section

The communication between two ends is done through SMS (Short Message Service). GSM receiver modem is interfaced to PC by connecting it to a PC serial port. The connection is checked between PC and mobile using Terminal where port connection is established. With suitable software the SMS from cell to the computer is accessed. Here AT commands are used for communication. GSM 600S module is used as it supports AT commands and is easily accessed in visual basic 6.0 software. A current data COM service over GSM generally allows transferring files or data and sending faxes at 9.6 kbps. Hence terminal baud rate is set to 9600bps; data bit is set to 8.

2) *Receiver section:*Block diagram representation of receiver is shown in Fig.3. The data received is logged into database supported by Open Data Base Connectivity (ODBC). The fields in database created are date, time, speed and cubic mean speed. Code is written to read the data from database. Manipulation is done to calculate speed (m/s) from the data that are obtained as frequency (Hz). The average and cubic mean values of daily, monthly, and yearly data are stored in separate database. Calibration of the received pulses to obtain wind velocity is done using:

$$v = f_p * 0.765 + 0.350 \quad m/s$$

Where, v is wind velocity in m/s, fp is the frequency of pulses, 0.765 is the scaling factor and 0.350 is offset.

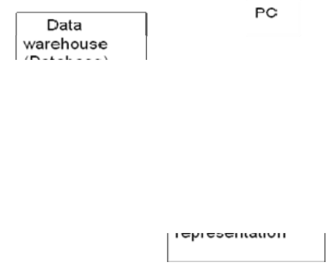

Fig.3 Block diagram of receiver section.

IV WORKING DESCRIPTION:

The following broad steps can achieve monitoring of wind speed using cellular communication.

1. Reading the revolutions of Anemometers for every 30 sec.
2. Sending these revolutions to transmitter module.
3. Providing a user interface at the transmitter module for storing 15 minutes data and send to GPRS/GSM module.
4. Sending stored data to the receiver GPRS/GSM as SMS for every 15 minutes.
5. Report generation for analysis of wind speed data.

The following steps explain the overall operation of the receiver module.

1. After every interval of 15 minutes SMS is received.
2. Extract the data from the SMS sent by remote transmitter module.
3. Separates individual bit of data for anemometer1 and anemometer2 calculate arithmetic mean and cubic mean cube root and stores separately in the database.
4. Provide graphical interface to the user.

Visual Basic is a graphic user interface (GUI) based programming tool, which provides a variety of drawing tools through which the user can draw anything imaginable on the form. The average and cubic mean values obtained are represented using Bar graph. The graph can be viewed as daily, monthly, and yearly.

V Results & Discussions:

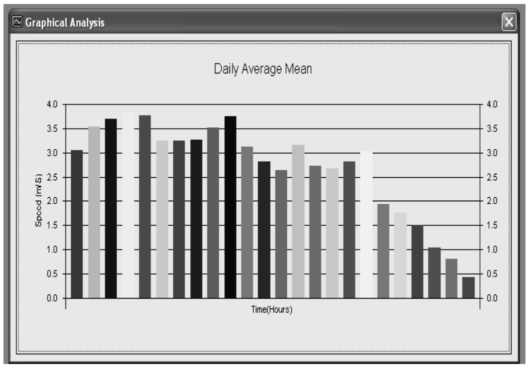

Fig.4 Daily arithmetic mean of Anemometer 2 for a typical day(22-02-2008)

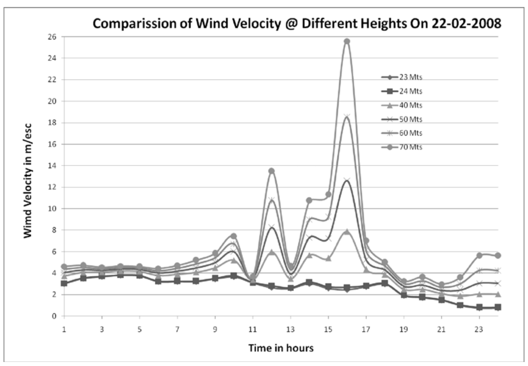

Fig. 5 Comparision of wind velocity at different heights.

TABLE 1: Comparison of proposed (WDA) system data with data of existing data logger (NRG).

$\overline{v}$ from WDA	$\overline{v}$ from NRG	Cubic Mean from WDA
4.21526	4.2	5.06398

Fig.4 represents the graphical presentation for a daily arithmetic mean of a typical day (22-02-2008) obtained by the proposed wind data analyzer. The provision is also made to view height extrapolation. Fig.5 represent the graphical view of different height extrapolation for different wind speeds on a typical day (22-02-2008). The accurate results are observed after comparing by using analytical method. More accurate results are obtained when compared with NRG wind data logger. Table –1 represents the comparison of arithmetic mean data of proposed wind data analyzer and NRG data logger for an hourly data for a typical day. From fig.5 it shows that both the results matches. Hence the proposed data logger can be effectively used for recording wind data from remote places.

VI Conclusion

The development and implementation of a wireless wind data analyser is presented in the paper. Global System for Mobile technology to read and transmit the wind data to a PC located at the work place is found to be a viable option. The output of anemometer is processed by microcontroller and transmitted to a personal computer via dedicated transmitter-receiver mobiles. The receiver mobile is interfaced to a personal computer, where the received wind data is analyzed to assess the wind potential, annual energy yield and siting. Two cup type anemometers, set up at different heights, are used for testing the proposed wind monitoring system. The output is compared with the wind data recorded using NRG wind data logger. The accuracy of the results show that the proposed data logger can be effectively used for recording wind data from remote places. The data logger helps in accurate assessment of wind potential at a site. It will be a useful tool for wind investors. The software can be further enhanced to incorporate the short term load forecasting.

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BIOGRAPHIES

Revansiddappa L. Badami was born in Bagalkot, Karnataka, India on 12th Jan 1969. He obtained B.E (Electrical & Electronics) degree from Karnataka University Dharwad in 1991, Post Graduate Diploma in Teaching Computer Applications from National Institute of Technical Teachers Training and Research (NITTTR), Channai in 1997 and M.Tech in Instrumentation & control Systems from NITC Calicut in 2008. His area of interest includes Digital electronics, Industrial Electronics, Computer networks, Control systems, Analog Electronics, mechtronics and wind Energy systems.Presently he is working as a Selection Grade

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He has attended National and International conferences. He has organized several Short Term Training Programs for teachers and students. He has played key role in setting up district level energy park and Rajiv Ghandhi Akshsy Urja Club in BEC campus, Bagalkot. He initiated setting up M.Tech in Power and Energy Systems in Electrical & Electronics faculty of VTU Belgium and was responsible for getting R & D center recognition to Electrical & Electronics Engg., Dept., BEC Bagalkot. He won the "Outstanding IEEE Student Branch Counselor" award for the 1996 at BEC Bagalkot, India. He is a Senior Member of IEEE, Life Member of Indian Society for Wind Engineering, Life Member of ISTE and Member of Institution of Engineering (India). He is the director for BVVS International programs and BEC-AICTE Coordinator. Presently he his working as a Professor in the Department of Electrical & Electronics Engineering at Basaveshwar Engineering College, Bagalkot. He is also adjunct visiting professor to MIT Manipal, and visiting Professor to EEED, BLDE CET, Bijapur.
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