Review Of SCADA For Wind Energy Generation

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Abstract

The name of SCADA itself is self-explanatory, SCADA system mainly supervises, acquires and controls the data that is received from a distant source from the SCADA system control centre. SCADA system is located in the control centre and is operated in scanning mode. The communication between the control centre and the remote station takes place by various communication channels such as optical fibre cables, microwave technology and power line carrier communication. Thus SCADA system mainly offer comfort level to the operator. The operator can control the power flow much effectively. Fault analysis and diagnosis of faults also becomes easy for operator. On the basis of information received, the operator is in a position to take important decision related to smooth generation, transmission and distribution of power. As the wind energy is available without any cost and it does not emit any green house gases. This makes it a great source of energy production for any developing state. The field of wind energy has tremendous scope for innovation, translating to real world applications and has tremendous economic opportunity. It is crucially important for India, as per our economy continues to evolve. The proposed research review provides an insight to SCADA systems for Wind energy generation and also explains various research methodologies that has been accomplished in the said area.

1. Introduction To SCADA

SCADA systems are installed in different substations to facilitate the day to day operations. They are also being installed in oil pipelines to detect leakage in pipelines. In fact in plants such as nuclear power plant where there is high risk to carry out the condition monitoring of the different auxiliary equipment by the help of manpower, SCADA systems automatically carry out this job by employing the use of field devices that continuously sense the operating states of different critical inaccessible equipment and pass on the information to the home station. The operator sitting at the home station can now see the status of all equipment on the display provided to him on operator console [13].

Supervisory control and data acquisition (SCADA) Systems are frequently used in water and waste water systems to monitor and control tank levels, remote well pumps, lift station pumps, high service pumps, valves, and chemical pumps. SCADA systems range from a simple to large configurations. Most of the SCADA applications use a human machine interface (HMI) software that permits users to interface with machine to control the devices. HMI is thus connected to motors, valves and many more devices.

The software of SCADA receives the information from programmable logic controllers (PLCs) or remote terminal units (RTUs), which in turn receives their information from sensors or inputted values which we have given manually. SCADA is used in a power system to collect, analyse and to monitor the data effectively, which will reduce the waste potentially and will improve the efficiency of the entire system by saving money and time.

The main objective of supervisory system is thus to give a means to the human operator to control and to command a highly automated process. Supervisory control and data acquisition systems (SCADA) are widely used in industries for supervisory control and data acquisition of industrial processes

1.1 SCADA System Functions

Sophisticated working environment has become the need of the hour. A large substation of 220 KV has all the switchgear such as power transforms, SF6 breakers, Isolators located outdoor. The running parameters such as voltage, frequency, power factor, active power, reactive power are captured in different monitoring devices fit in the different PCC [Power Control Centre] panels in the substation control room. The substation operator has to take rounds of the substation control room and outdoor yard to visually inspect each and every equipment in order to fill necessary technical monitoring information in his logbook per shift. In case of the occurrence of any fault on substation it also becomes tedious task to carry out the fault diagnosis [14]. SCADA system performs various functions. These functions are as under:

1.1.1 Data acquisition: In Data acquisition the basic information related to the power system is collected by equipment in the various substations and power plants. The data can be entered manually or it can be calculated also.

1.1.2 Networked data communication: Communication network is used in SCADA systems to pass data between devices or master station or host computer. The host computer can also be a PLC (programmable logic controller). The individual PLCs are connected to the operator interface equipment at the central control room.

1.1.3 Data presentation: The only display element in our model SCADA system is the light that comes on when the switch is activated. We need our SCADA system to report intelligent and usable data to the appropriate person in a timely manner. A real SCADA system reports to human operators over a specialized computer that is variously called, an HMI (Human Machine Interface).

1.1.4 Control: Control functions are an important class of functions that affect the power system. They are initiated either by the operator or automatically through software.

These functions are performed by four kinds of SCADA components:

a) Sensors (either digital or analog) and the control relays that directly interface with the managed system.
b) Remote telemetry units (RTUs): These are the small computerized units deployed in the field at specific sites and locations. RTUs serve as a local collection points for gathering reports from a sensors and thus delivering commands to control relays.
c) SCADA master units: These are the larger computer consoles that serves as the central processor for the SCADA system. Master units provide a human interface to the system and automatically regulate the managed system in response to the sensor inputs.
d) The communications network that connects the SCADA master unit to the RTUs in the field.

1.2 SCADA Benefits

SCADA is the solution for industrial automation. It enables you to achieve monitoring and controlling your plant operation remotely. Field instruments and devices will be linked to SCADA engine and PLC, therefore you can simply trigger via SCADA screens (HMI) to control your instruments, as well as simply monitor any live data and status via the screens. This benefits both operators or supervisors in operating the process, as it is able to reduce much time and efforts [15]. Following are the various benefits of SCADA system [15] :

1.2.1 Quality of service improvement: Cyber security threats and attacks are greatly affecting the security of critical infrastructure, industrial control systems, and supervisory control and data acquisition (SCADA) control systems. In SCADA networks, there exists little or scare information about SCADA vulnerabilities and attacks.

1.2.2 Reliability improvement: through the data provided by SCADA systems, investor-owned utilities have been able to improve grid reliability, proactively detect and resolve problems, meet power quality requirements, and support strategic decisions.

1.2.3 Operating cost reduction: A SCADA system saves time and costs by allowing an operator at master control facility the ability to monitor and control all processes that are distributed among various remote sites.

1.2.4 High value service providers: Both large and small systems can be built using the SCADA concept. These systems can range from just tens to thousands of control loops, depending on the application.

1.2.5 Improved information for engineering decision: The SCADA system may allow operators to change the set points for the flow, and enable alarm conditions, such as loss of flow and high temperature, to be displayed and recorded.

1.2.6 Value added services: SCADA International for years assisted customers all over the world in optimizing and protecting their investment by providing valuable and advantageous value adding services.

1.2.7 Manpower requirements reduction: SCADA system monitors whole power system. whenever any fault occurs in any equipment the SCADA system locates the exact fault location through central host computer and takes the necessary measures to remove the fault through central host computer. Thus SCADA system reduces the manpower required to remove the fault.

2. SCADA IN RENEWABLE ENERGY

Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it is derived directly from the sun, or from the heat generated deep within the earth. Included in the definition is electricity and heat generated from the solar, wind, ocean, hydropower, biomass, geothermal resources, and bio-fuels and hydrogen derived from renewable resources.

Collecting, combining and distributing renewable energy is complex business based on many levels: differences in frequency and voltage, inconsistencies in power provided by each asset, assessment of the demand for the power and capacity of the grid to take it [16], [17].

Growing attention towards clean and inexhaustible energy has led to the creation of many renewable power plants, particularly wind and photovoltaic. These facilities, often large and geographically distributed, require easily deployable and expandable remote control and management tools to ensure an efficient and effective management.

Proteco proposes solutions already used in small and large photovoltaic systems and in wind farms, with supervision and local control tools, including system remote management gateways, together with remote control and remote oriented centres for system management performance optimization.

A key trait of SCADA is that it works across all types of generation assets. Wind, geothermal, hydro, solar, gas, whatever the energy source, we have a standard SCADA template to connect it to the network. The first benefit operator's gain is the ability to monitor all of the assets both from the production perspective (how much energy is each producing?) and asset health perspective (what is its condition?). Answers to these two critical questions ensure operators get the most from each asset and avoid downtime surprises. Beyond managing the assets at the operational level, SCADA provides the data necessary to make well informed commercial predictions and decisions. The real-time and stored data enable more accurate, data based forecasting both in the very short term (hours) and near term (days). The internally focussed operational data can be combined with the externally focussed market and the grid status data to make the best choices about when, where and who sell energy to.

The US/Canada renewable energy project is impressive, but it is not a unique. Other energy providers are developing equally large and complex portfolios, and scale of these portfolios is likely to grow even larger. One of the central benefits of SCADA is its scalability, making it the monitoring and control technology of choice for these vast energy webs. Through SCADA, renewable energy providers can operate most efficiently, increase revenue, and maximize the return on their investment.

3. SCADA FOR WIND ENERGY GENERATION

Wind power is an important source of renewable energy for which the UK has a excellent resource. Wind turbines are generally grouped together to form wind farm. Here the author describes how SCADA system play key role in distributed control system used to operate and maintain wind farm.

SCADA is for remote supervision and control of a wind turbines and wind parks The SCADA system from wind power technology offers full remote control and supervision of entire wind park and the individual wind turbines. The SCADA system can run on a computer in the control room of the wind park or it can run on any internet connected computer accessing the wind park using TCI/IP [18].

Here are the main features of SCADA system in wind energy generation:

Park Overview: Park overview of the SCADA system provides a graphical overview of the wind park indicating the status of each individual turbine. Furthermore, current wind and production data are shown.

Park Control: The Park Overview makes it possible to start/stop entire wind park, clusters of turbines or individual wind turbines. Furthermore the park control can be used for setting production limits for the wind park.

Turbine Overview: The Turbine Overview of SCADA system gives a full overview of all relevant parameters of wind turbine, for instant temperatures, pitch angle, electrical parameters, rotor speed, yaw system etc.

Log Viewed: The SCADA system features a flexible browsing of the log data of wind turbine. All relevant log data are accessible and can be sorted by different parameters.

Report Generator: The Report Generator of SCADA system makes it possible to make all relevant reports based on the log data. The reports can be graphically presented to provide the best possible overview.

The Wind Energy Generation based on SCADA System is shown in fig 1 below:

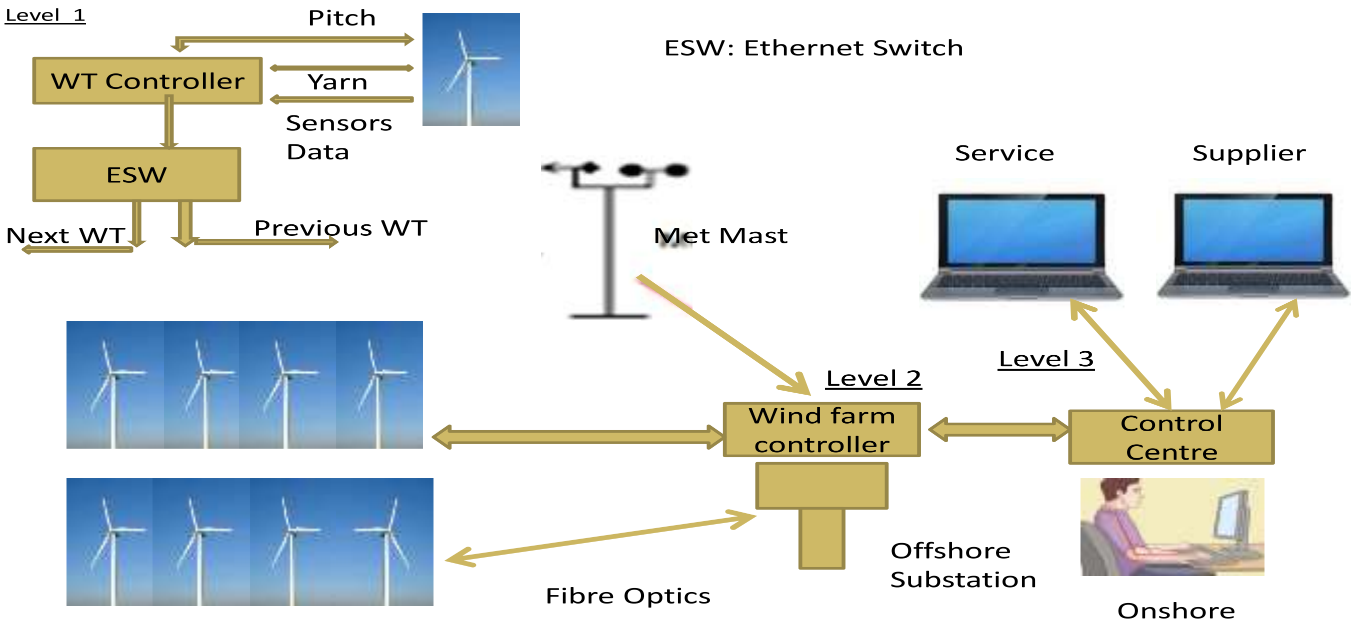

Fig 1: SCADA based wind energy generation

The SCADA system can be used for a larger wind farms. A wind farm is a group of wind turbines in the same location used to produce electricity. A large wind farm may consist of several hundred individual wind turbines and cover an extended area of hundreds of square miles. For such a larger area, it is not possible to visit each and every turbine to collect all the data like, daily generation, warning, status, message, faults etc. So in that case SCADA system is utilised to monitor the turbine from a single platform and keeping the record of generations (KWH) and faults. In SCADA system all the turbines are connected with single server either by optical fibre or by GSM network.

SCADA can be used for small wind turbines that are being used for standalone application but it will not be financially viable as it will add extra cost to turbine in case to visit the turbine to collect the data and attend the faults.

SCADA really just refers to all the data collected by various sensors and supervisory control aspects. Supervisory control is things like requesting (from the central park controller) the turbines to start or stop due to electricity stop price signals or to take advantage of low wind speeds to perform a maintenance routine. Critical control like high speed shut down, emergency brake programs, pitching, speed control/active power regulation etc are performed within the turbine controller and are not considered SCADA (although the turbine controller produces SCADA data

4. SCADA DATA ANALYSIS FOR WIND FARM

The vital element of wind farm is the SCADA system. This system acts as a nerve centre for the project. It connects individual turbines, the substations, and metrological stations to a central computer. This computer and the associated communication system allow the operator to supervise the behaviour of all wind turbines and also the wind farm as a whole. It will keep the record of all the activity on a 10 minute basis and allows the operator to determine what corrective action, if any, needs to be taken. The SCADA system also has to implement any requirement in the connection agreement to control reactive power production, to contribute to network voltage or frequency control, or to limit power output in response to instruction from network operator [19].

SCADA system is usually provided by the turbine supplier for contractual simplicity. There is also a market for SCADA system from independent suppliers. The major advantages of this route are claimed to be:

a) Identical data reporting and analysing formats, irrespective of turbine type, this is important for wind farm owners or operators who have projects using different wind turbines.

b) Transparency of calculations of availability and other possible warranty issues.

In addition to the essential equipments needed for functioning wind farm, it is also advisable, if the project size can warrant the investment, to erect some permanent metrological instrumentation on met masts. This equipment allows the performance of the wind farm to be carefully monitored and understood. If wind farm is not performing accordingly to its budget it will be important to determine whether this is due to poor mechanical performance or less than expected wind resources in the absence 0f good quality wind data on the site it will not be possible to make this determination. Large wind farms contain one or more permanent metrological masts, which are installed at the same time as the wind farm [20].

5. LITERATURE SURVEY

The literature survey is conducted on different energy management systems fetching the data from the generation to consumption by using different means and approaches. Based on different papers the smart energy architecture is proposed and a smart energy data warehouse is implemented for smart grid. With the wide use of wind energy resources the traditional energy resources have been adjusted and modulated. In the recent years, supervisory control and data acquisition (SCADA) system has been applied in power system substation automation and becomes a focus of electrical utility. A brief literature survey related to SCADA based wind energy generation is given below:

R. Palma-Behnke, D. Ortiz, L. Reyes, G. Jimenez-Estevez, N. Garrido, ''A Social SCADA Approach For Renewable Based Micro-grid – The Huatacondo Project'',2011 has presented a paper which proposes a novel SCADA approach for renewable based micro-grid. The optimization scheme provides online set points for each generation unit, operation modes for a water supply system, and signals for consumers based on a demand side management mechanism. This concept is applied to a smart micro-grid composed of photovoltaic panels, a wind turbine, a diesel generator, a battery bank and a water supply system. The result shows the economics of energy management system and impact of community participation [1].

N Chen, R Yu, Y Chen, H Xie ''A Hierarchical method for Wind Turbine prognosis using SCADA data'', 2016, gave a paper in which a hierarchical method based on GP (Gaussian processes) and PCA (Principal Component Analysis) is proposed for turbine prognosis using SCADA data. The method includes two levels of prognosis: 1) detect which wind turbine behaves abnormally and has potential defect. 2) determine the defective components in the abnormal turbine. The field dataset including 24 failed turbines is used to validate the proposed hierarchical method. Thus the validation results show that the proposed method can achieve wind turbine prognosis with 79% detection rate on turbine level and 75% detection on component level [2].

B Chen, YN Qiu, Y Feng, PJ Tavner, WW Song ''A Wind Turbine SCADA Alarm Pattern Recognition'', 2011, gave a paper which develops a wind turbine supervisory control and data acquisition (SCADA) system that contains a alarm signals providing significant important information. The pattern recognition embodies a set of promising techniques for intelligent processing wind turbine SCADA alarms. This paper presents the feasibility study of SCADA alarm and diagnosis method using an artificial neural network (ANN). Based on this study, we have found that the general mapping capability of the ANN help to identify those likely wind turbine faults from SCADA alarm signals, but a wide range of representative alarm pattern are necessary for supervisory training [3].

Yang Hu, Jizhen Liu, Taihua Chang, Wei Li, Zhongwei Lin ''Effective wind speed estimation and optimized setting strategy for WTGS based on SCADA system'' 2014, has presented a paper that proposes a useful procedure to complete the effective wind speed estimation online combining mechanism inference and adaptive data processing algorithm. According to the effective wind speed, an optimum setting strategy is formulated. The validation is executed and simulation results thus show the availability of the approaches. The historical data in supervisory control and data acquisition (SCADA) system is used and adaptive neuro-fuzzy inference system (ANFIS) is adopted [4].

Xingzhen Bai, Xiangzhong Meng, Zhaowen Du, Moofa Gong Zhinguo Hu ''A Design Of Wireless Sensor Network in SCADA System for Wind Power Plant'', 2008 has presented a paper in which wireless sensor network (WSN) is a novel technology, which is developed with the advancement of technology, computing and wireless communication technology. As to the energy limitations of WSN, the method of automatic compensating energy by wind generator is provided [5].

Michael Wilkinson, Brian Darnell, Thomas Van Delft, Keir Harman ''A Comparison Of Methods For Wind Turbine Condition Monitoring With SCADA data'', 2014 has presented a paper in which wind turbine operational costs can be reduced by monitoring the condition of major components in the drive train. Three SCADA based monitoring methods were thus reviewed: Signal trending, Self-organizing maps and Physical model. A validation study on this method using five operational wind farms showed that it is possible to achieve a high detection rate and a good detection accuracy. SCADA based condition monitoring is attractive because the data are already collected, resulting in rapid deployment and modest set-up cost [6].

Linas Gelazanskas, Kelum A.A Garmage, ''Managing Renewable Intermittency in Smart Grid: Use of residential hot water heaters as a form of energy storage'', 2016, has presented a paper which discusses a novel wind generation balancing technique to improve renewable energy integration to the system. The novel individual hot water heater controllers were modelled with the ability to forecast and look ahead the required energy, while responding to the electricity grid imbalance. The method developed in this research are not limited to wind power balancing and can be also used with any other type of renewable generation source. Artificial intelligence and machine learning techniques were used to learn and predict energy usage [7].

W.A.M. Ghoneim, A.A. Helal, M.G. Abdel Wahab, ''Renewable Energy Resources and Recovery Opportunities in Waste Water Treatment Plants', 2016, has presented a paper which describes the different methodologies for energy recovery and renewable energy utilization techniques in waste water treatment plants which are one of the largest consumable of electric power. To reach self-sustainability the plant can get thus the rest of its energy demand through convectional renewable resources such as solar, wind, hydro and tidal power [8].

Se-Yoon Kim, In-Ho Ra, Sung-Ho Kim, '' Design of Wind Turbine Detection System based on performance curve'', 2012, has presented a paper in which wind turbine fault detection system based on wind verses power performance curve obtained from SCADA is studied. SCADA data obtained from 850 KW wind turbine system installed in Kunsan Korea are used and various simulation studies were carried out [9].

Ran Bi Chengke Zhou, Donald M Hepburn, ''Applying instantaneous SCADA data to artificial intelligence based power curve monitoring and WTG fault forecasting'', 2016, has presented a paper in which SCADA data is used to show the fault forecast ability of artificial intelligence based PC monitoring of a pitch regulated WTG. Thus the measured PCs illustrate that the instantaneous data is better than averaged data, widely used in literature, to present the dynamics of a WTG operation. Thus the comparison is based on mean absolute error (MAE), root mean squared error (RMSE) and a correlation coefficient (R square). The result shows that the models considering generator speed and pitch angle performs better with lowest MAE and RMS [10].

Yanjun Yan, James Zhang, ''Using Edge-Detector to model wake effects on wind turbines'', 2014, has presented a paper in which healthy wind turbine is essential for wind energy generation and fault monitoring is required to detect faults accurately. One major phenomenon that is not fault but will cause power reduction is wake effect. Our approach is driven by the data, without any pre-determined modelling and hence it is automatic, adaptive and widely applicable. The accurate wake pattern generated by our approach is helpful to separate wakes from true faults and to understand the vulnerability of the turbines [11].

Qui Yingning Sun Juan, CAO Mengnan FENG Yanhui, Yang Wenxian, David Infield, '' Model Based Wind Turbine Gearbox Fault Detection On SCADA Data'', 2014, has presented a paper in which typical wind turbine gearbox condition monitoring is based on vibration signals, which is effective to detect failure with high frequency signal range. To systematic understand wind turbine systems, this paper presents research results of model based wind turbine gearbox fault detection. The result obtained in this work is useful for wind turbine gearbox design and effective algorithm development of fault detection [12]

6. Comparative Analysis

S.NO	RESEARCHERS NAME	TITLE	METHOD USED	TOOLS USED
1	R.Palma-Behnke, D Ortiz L Reyes, G Jimenez-Estevez, N. Garrido et al [1]	A Social SCADA approach for a renewable based micro-grid	Optimization scheme provides online set points for each generation unit	SCADA system Based on HMI, Social SCADA (S- SCADA)
2	Niya Chen, Rongrong YU, Yao Chen, Hailian Xie et al [2]	Hierarchical method for wind turbine prognosis using SCADA data	Analysis on WT prognosis method which can give alarm before actual failure happens	SCADA system
3	Yong Hu, Jizhen Liu, Zhongwei Lin and Hongmin Meng et al [4]	Effective wind speed estimation and optimized setting strategy for WTGS based on SCADA system	The signal of effective wind speed plays an role in process control in WTGs	ANFIS, FIS
4	Xingzhen Bai, Xiangzhong Meng et al [5]	A design of wireless sensor network in SCADA system for wind power plant	Analysis on WSN the method of automatic compensating energy by wind generator is used	80C51, ARM chip, IDD-PC, UC/OS-II
5	Michel Wilkinson, Brian Darnell, Keir Harman, Thomas van delft et al [6]	A comparison of methods for wind turbine condition monitoring with SCADA data	SCADA based monitoring method is used: signal trending, self organising maps and physical model	ANN, SOM - SCADA system
6	Linas Gelazankas, Kelu m A.A Garnage et al [7]	Managing renewable intermittency in smart grid: use of residential hot water heaters as form of energy storage	Analysis a novel wind generation balancing technique to improve renewable energy integration to the system	Hot water heater controller, ANN, DSM

7	W.A.M Ghoneim, A.A Helal, M.G. Abdel Wahab et al [8]	Renewable energy resources and recovery opportunities in wastewater treatment plants	Use of embedded energy resources that could be recovered and reduce the energy requirement of plant	Combined heat and power (CHP) technologies, WWTP, NOPWSD
8	Se-Yoon Kim, IN Ho Ra, Sung-Ho Kim et al [9]	Design of wind turbine detection system based on performance curve	Analysis on wind turbine fault detection system based on wind verses power performance curve obtained from SCADA	CMS, AI techniques
9	Ran Bi, Chengke Zhou, Donald M Hepburn et al [10]	Applying instantaneous SCADA data to artificial intelligence based power curve monitoring and WTG fault forecasting	The influence of ambient temperature, generator speed and pitch angle have effect on WTG generation	WTG, CMS, ANN, ANFIS, NBM
10	Yanjum Yan and James Zhang et al [11]	Using edge detector to model wake effects on wind turbines	We propose to use linear prediction based on entropy threshold method for edge detection	SCADA system, linear prediction, entropy based edge detector
11	QUI Yingning, SUN Juan, CAO Mengnan, WANG Hao, INFIELD David et al [12]	Model based wind turbine gearbox fault detection on SCADA data	Using classical method to develop fault detection algorithm	WT Gearbox lubrication system, SCADA data
12	B Chen, YN Qiu, Y Feng, PJ Tavner, WW Song [3]	A wind Turbine SCADA Alarm pattern recognition	Using SCADA System methods to obtain alarm signals	ANN, SCADA system

7. PROPOSED RESEARCH METHODOLOGY TO BE FOLLOWED

Wind energy is one of the new and renewable resources that have the most favourable development prospect, which can replace many one-off resources in some uses, wind power generating technology is made more and more attentions. SCADA system for the wind plant is the process control and schedule system of wind power generation. It can realize the automatic surveillance of wind speed, wind direction, the long-distance online diagnosis and control of wind generator, which provides safeguard for safe and effective running of wind power plant. SCADA in wind power system, can guarantee system information integrity, group the wind power systems, enhance production efficiency, and help correctly diagnoses the system failure condition fast. Various methods have been used in this research. The method used in this research will be dealt in the following steps:

1. Collecting and understanding of relevant material in the form of books/journals and web resources for wind energy based on SCADA system.
2. Using edge detector to model wake effects on wind turbines for efficient wind energy generation and fault monitoring is required to ensure to detect faults accurately while reducing false alarms, we need to identify temporary power generation loss that is not due to fault.
3. The instantaneous SCADA data is used to show the fault ability of artificial intelligence based PC monitoring of pitch regulated WTG. Then comparison is done based on mean absolute error and root mean absolute error.
4. Typical wind turbine gearbox condition monitoring is based on vibration signal which is effective to detect failures with high frequency signal range. 0
5. The wind turbine conditioning monitoring ANN have potential to identify changes in relationship between SCADA signals that indicate the development of a failure. Multiple ANN methods have been investigated and self organising map (SOM) has been identified as promising in the context.
6. The optimisation method is used to provide on line set points for each generation unit for social SCADA approach for renewable based on a demand side management mechanism.
7. Wind turbine health condition or state of wind turbine components can be deduced through rigorous analysis of SCADA and CMS data.
8. Wind turbine supervisory control and data acquisition (SCADA) system contain alarm signals providing significant important information. Pattern recognition embodies a set of promising techniques for intelligently processing wind turbine SCADA alarms.
9. Different kinds of methodologies have already been applied in SCADA based wind turbine condition monitoring. The non linear state estimation technology is used to diagnose gearbox failure in neural network and fuzzy logic and these are combined for large wind turbine condition monitoring.

8. CONCLUSION

Supervisory control and data acquisition (SCADA) provides a architecture which makes use of networked computers with a running GUI application connected to various programmable peripheral devices for efficient supervisory management. SCADA systems are crucial for any organization in achieving efficiency, processes data for smarter decisions, and communicate system issues to help mitigate downtime. The SCADA provides a communication between controllers (PLCs) with remote terminal units (RTUs). The data is collected from sensors and transmitted remotely to RTU where it gets stored and analyzed for efficient decision making.

The proposed paper provides a novel way for integrating community, through a SCADA system, in projects of renewable energy based micro grids. The S-SCADA is a computational tool that takes into account social aspects for its design. This is developed with the aim that community performs the micro grid managing, performing maintenance tasks, consumption and generation monitoring and decision making processes among others. Thus community is involved with the project and ensures its permanence in the long term the application provides sustainability indicators that show the community evolution throughout the time. This instrument allows community to make decisions not only concerning the electrical system but also related to aspects like security, income, etc.

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