CHAPTER 1

INTRODUCTION

* 1. GENERAL INTRODUCTION

Wind energy has emerged as a highly promising source of renewable energy in recent times. However, wind turbines regularly suffer from operational inconsistencies, leading to significant costs and challenges in operations and maintenance. Condition-based monitoring (CBM) and performance assessment/analysis of turbines are vital aspects for ensuring efficient operations and maintenance planning and cost minimization. Data-driven decision making techniques have witnessed rapid evolution in the wind industry for such operations and maintenance tasks during the last decade, from applying signal processing methods in early 2010 to artificial intelligence (AI) techniques, especially deep learning in 2020.

Here we utilise statistical computing to present a scientometric review of the conceptual and thematic evolution of AI in the wind energy sector, providing evidence-based insights into present strengths and limitations of data-driven decision making in the wind industry. Here we provide a perspective into the future and on current key challenges in data availability and quality, lack of transparency in black box-natured AI models, and prevailing issues in deploying models for real-time decision support, along with possible strategies to overcome these problems.

* 1. GOAL OF THE PROJECT
* **The system will collect data directly from the wind farms with monitoring and report generation in real-time, to improve decision making and reliability. Thiscan result in increased efficiency, better spare-parts forecasting, reduced downtime, and lower unplanned maintenance costs.**
* **Create AI models of normal turbine behavior, which serve to quickly identify abnormalities and notify the wind-farm operator.**
* **Many types of forecasts are possible, including power production, availability, spare parts needs, and other such use cases.**
* **Informs about the components that are likely to fail and helps in replacing the components in due time.**

CHAPTER 2

LITERATURE SURVEY

2.1 STUDY OF SIMILAR WORK

Control of Synchronous Generator in Wind PowerSystems Using Neuro-Fuzzy Approach

This system presents the control scheme of a synchronous generator in wind energy power system using adaptive neuro-fuzzy approach. A neuro-fuzzy-based controller is used for controlling a permanent magnet synchronous generator (PMSG) that is used in wind power systems. The variables have been controlled are the angular velocity, dc voltage, reactive power, active power, a phase current and voltage phase of generator output. The simulation results show that the adaptive neuro-fuzzy controller has successfully controlling all variables in a relatively short time to get back to a stable state.

Production of electricity from renewable energy sources like wind energy increases due to environmental problems and the shortage of traditional energy sources. Nowadays, permanent magnet synchronous generators (PMSG) are used in wind turbine because of its advantages: better reliability, less maintenance and more effective. In this system the control scheme of a synchronous generator in wind energy power system using adaptive neuro-fuzzy approach. A neuro-fuzzy-based model reference adaptive system is continuously tuned with actual permanent magnet synchronous generator (PMSG)to neutralize the effect of parameter variations such as stator resistance, inductance, and torque constant. This neuro-fuzzy-tuned estimator is able to estimate the rotor position and speed accurately over a wide speed range with a great immunity against parameter variation.

2.1.1 EXISTING SYSTEM

The current system is using software only for maintaining

* Employ attendance-Software is able to mark the employ attendance and managing the leave register.
* Staff management-Manually and automatically arranges the shift of the employees and maintaining the staff in a HR manner.
* Expense management- Accounting the overall wind mill expense and recording the amount of energy generated. Also calculate the profit and loss made by the wind mill.

2.1.2 DRAWBACKS OF EXISTING SYSTEM

Existing management system is not integrated, they have separate employee attendance system and accounts software. No AI models are created for predicting turbine behavior, power production etc. Because of not forecasting the maintenance requirements and spare parts needs, heavy financial loss is there due to the unexpected shutdown of wind mills. Manpower utilization is also not in a better way, since there is no manpower management system is present in the current software. Wind speed forecasts can boost the quality of wind energy generation by increasing the efficiency and enhancing the economic viability of this variable renewable resource, this feature is also not available in existing system.

CHAPTER 3

OVERALL DESCRIPTION

3.1 PROPOSED SYSTEM

The proposed method proved to provide an effective way of fault identification at minimum cost. The method further proves to minimize the maintenance cost as well by saving the components prior to the occurrence of the intensive faults. The accuracy of the method and the error rate of the method were considerably low compared to the existing methodologies. **In addition to the whole farm monitoring, data from the individual turbines will allow detection of deviations from the design parameters and potential emerging maintenance issues.**

AI models are used for maintaining wind mills operations. **The sources from which AI can pull information may include maintenance data, failure histories, and management software. Here software serve to quickly identify abnormalities and notify the wind-farm operator. Many types of forecasts are possible, including power production, availability, spare parts needs, and other such use cases. Having such increased visibility provides tremendous benefits to wind-turbine operators.**

3.2 FEATURES OF PROPOSED SYSTEM

Creating AI models for increasing **efficiency, better spare-parts forecasting, reduced downtime, and lower unplanned Maintenance costs. This system will collect data directly from the wind farms with monitoring and report generation in real-time, to improve decision making and reliability. Informs about the components that are likely to fail and helps in replacing the components in due time. Predict the parts which may fail before the failure of that particular part.**

3.3 FUNCTIONS OF PROPOSED SYSTEM

* Fault detection optimization- Detecting machine faults at an early stage of development is one of the fundamental concepts of machine condition monitoring. The objective is to detect developing faults as early as possible so the lead-time up to the point where operational/productional capacity drops off as the fault develops and is sufficient for cost-effectively planning maintenance up until that time.
* Prognostics to failure**-** After a fault has been automatically detected and the specialist has sufficiently identified the fault, determined its severity, and established a trend, the next step is to predict when the component needs to be replaced or repaired with minimal maintenance intervention and without interrupting production
* Speed sensor substitute- Speed reference sensors are used extensively in wind-turbine condition monitoring. Wind turbines inherently operate at a wide range of speeds because of variable wind conditions, and because the gearbox itself has several speeds according to the stages built into it, ranging from the low-speed blade hub up to the high-speed generator.
* Collects **maintenance data, failure histories, and management software, which are used to create AI models**

**Here it collects every data of a wind mill operation and evaluate it for training AI norms. This can predict the outcomes early before it happen.**

* **Analyzing energy produced and its expense.**

3.4 REQUIREMENTS SPECIFICATION

System analyst tasks to a variety of persons to gather details about the business process and their opinions of why things happen as they do and their ideas for changing the process. These can be done through questionnaires, details investigation, observation, collection of samples etc. As the details are collected, the analyst study the requirements data to identify the features the new system should have, including both the information the system produce and operational features such as processing controls, response times, and input output methods.

Requirement specification simply means, “Figuring out what to make before you make it”. It determines what people need before you start developing a product for them. Requirement definition is the activity of translating the information gathered in to a document that defines a set of requirements. These should accurately reflect what consumer wants. It is an abstract description of the services that the system should provide and the constraints under the system must operate.

The notations used for requirements definition should be based on natural languages, forms and simple intuitive diagrams. The requirements fall into two categories: functional requirements and non-functional requirements.

The requirements of specification of the proposed system are as follows:

* Minimum time needed for various processing
* Better Service
* Faster response time

3.5 FEASIBILITY ANALYSIS

The main aim of the feasibility study activity is to determine. Whether it would be financially and technically feasible to develop the product. The feasibility study activity involves analysis of the problem and collection of all relevant information relating to the product such as the different data items which would be input to the system the processing required to be carried out of these data, the output data required to be carried out of these data, the output data required to be produced by the system, as well as various constraints on the behavior of the system.

In our software we would find the actual requirements of this software and add that features Such as monitoring, process scanning etc. For adding this feature, we will like take different ways to solving this last find the best way to complete these features.

Feasibility studies aim to objectively and rationally uncover the strengths and weakness of the existing business or proposed venture, opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success. In its simplest term, the two criteria to judge feasibility are cost required and value to be attained As such, a well-designed feasibility study should provide a historical background of the business or project, description of the product or vice, accounting statements, details of the operations and management, marketing research and policies, financial data, legal requirements and tax obligations. Generally, studies precede technical development and project implementation.

3.5.1 TECHNICAL FEASIBILITY

The assessment is based on an outline design of system requirements in terms of Input, Processes, Output, Fields, Programs, and Procedures. This can be quantified in terms of volumes of data, trends, frequency of updating, etc. in order to estimate whether the new system will perform adequately or not. Technological feasibility is carried out to determine whether the company has the capability, in terms of software, hardware, personnel and expertise, to handle the completion of the project when writing a feasibility report, the following should be taken to consideration. A brief description of the business the part of the business being looked towards. The human and economic factor the possible solutions to the problems.

The system is technically feasible.

3.5.2 OPERATIONAL FEASIBILITY

Operational analysis is the most frequently used method for evaluating the effectiveness of a new system. More commonly known as cost/benefit analysis, the procedure is to determine the benefits and saving that are expected from a candidate system and compare them with costs. If benefits outweigh costs, then the decision is made to design and implement the system. An entrepreneur must accurately weigh the cost versus benefits before taking an action. Cost-based study: It is important to identify cost and benefit factors, which can be categorized as follows:

1. Development costs.
2. Operating costs.

This is an analysis of the costs to be incurred in the system and benefits derivable out of the system. Time-based study: This is an analysis of the time required to achieve a return on investments the future value of a project is also a factor. The system is operationally feasible.

CHAPTER 4

OPERATING ENVIRONMENT

4.1 HARDWARE REQUIREMENTS

Processor : Intel i5 8th Gen

RAM : 16GB ddr4

Hard disk : 2048 GB SSD

Drives : CD ROM, C-type Port, USB 3.1\*2 Port

Display Size : Compatible Size (Recommend 15’inch)

Screen Resolution : 1920\*1080 Pixels

Keyboard : Wireless Enabled Keyboard (Recommend: Logitech)

Keyboard Mouse : Wireless Enabled Mouse (Recommend: Logitech)

Monitor : Touch Capacity LED Monitor

Dedicated Graphics Card : Nvidia GeForce GTX 1050 4GB DDR5

Camera : 8 Megapixel Full HD 1.8f lens

Extra : Wi-Fi Adapter, Bluetooth Adapter

4.2 SOFTWARE REQUIREMENTS

Operating System : Windows (7/8/10)/Ubuntu (14/16/18/20)

Software Drivers : Wi-Fi drivers .Bluetooth Drivers, Visual Studio Drivers Nvidia GeForce Graphics drivers, Intel Drivers and Camera Drivers

Programming Language : Python

IDE : OpenCV, keras

Scripting Languages : HTML, CSS, JavaScript

Web Browser : Google Chrome

Front-End : Python, Django

Back-End : My SQL

4.3 Tools and platforms

4.3.1 PYTHON:

Python is a general purpose, dynamic, high-level, and interpreted programming language. It supports Object Oriented programming approach to develop applications. It is simple and easy tolearn and provides lots of high-level data structures. Python is easy to learn yet powerful andversatile scripting language, which makes it attractive for Application Development. Python'ssyntax and dynamic typing with its interpreted nature make it an ideal language for scripting andrapid application development. Python supports multiple programming pattern, including object oriented,imperative, and functional or procedural programming styles. Python is not intended towork in a particular area, such as web programming. That is why it is known as multipurposeprogramming language because it can be used with web, enterprise, 3D CAD, etc.

**Features of Python**

* Easy-to-learn − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
* Easy-to-read − Python code is more clearly defined and visible to the eyes.
* Easy-to-maintain − Python's source code is fairly easy-to-maintain.
* Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
* Interactive Mode − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
* Portable − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
* Extendable − Can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
* Databases − Python provides interfaces to all major commercial databases.
* GUI Programming − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
* Scalable − Python provides a better structure and support for large programs than shell scripting.

4.3.2 MySql

MySQL Server is the world's most used relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. This stores data in the form of multiple related tables. The SQL phrase stands for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

**Features of MySQL**

* Relational Database Management System (RDBMS) - MySQL is a relational database management system.
* Easy to use - It is easy to use. You have to get only the basic knowledge of SQL. You can build and interact with MySQL with only a few simple SQL statements.
* Secure - MySQL consist of a solid data security layer that protects sensitive data from intruders. Passwords are encrypted in MySQL.
* Free to download - MySQL is free to use and you can download it from MySQL official website.
* Scalable - MySQL can handle almost any amount of data, up to as much as 50 million rows or more. The default file size limit is about 4 GB. However, you can increase this number to a theoretical limit of 8 TB of data.