Aero2Astro

Task 4

Report

By

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Wind Turbine:

A wind turbine is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of sizes, with either horizontal or vertical axes.

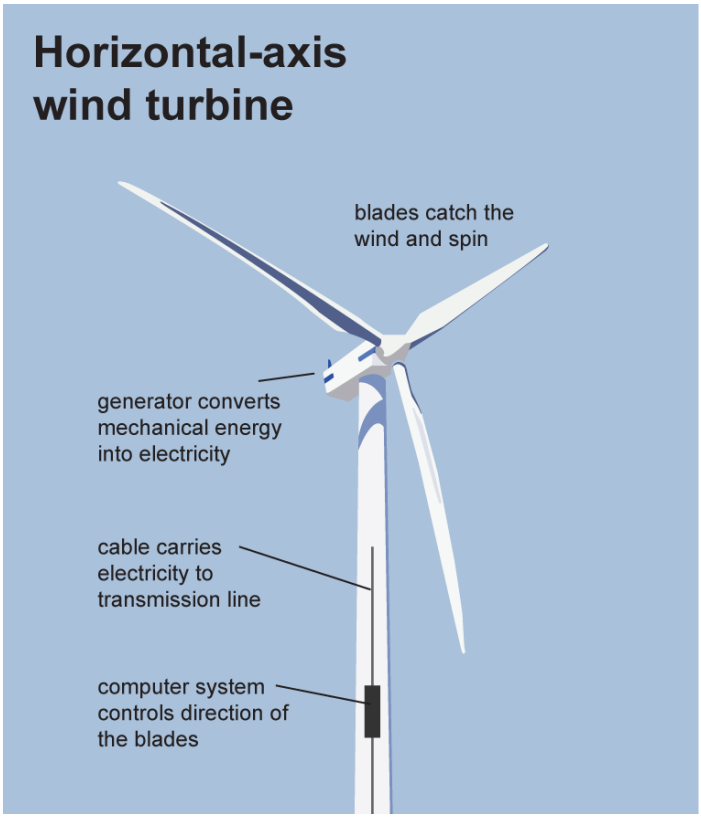
Types of wind Turbine

There are basically 2 types of wind turbines. They are

1. Horizontal-axis turbines
2. Vertical-axis turbines

1. Horizontal-axis turbines

Horizontal axis wind turbines, also abbreviated to HAWT, are a common style that most of us think of when we think of wind turbines. HAWT has a similar design to the windmill, with bullets that look like a propeller orbiting a horizontal axis. Horizontal axis wind turbines have a large rotor shaft and an electric generator on top of the tower, and should be shown in the air. Horizontal axis wind turbines are the most widely used engine machines due to their power and efficiency. The base of the towers should be extremely strong, allowing the rotor tube to be mounted on top of the tower allowing the turbine to be exposed to strong winds.



Benefits

1. The base of the tall tower allows for strong air access to sites with wind shear.
2. High efficiency

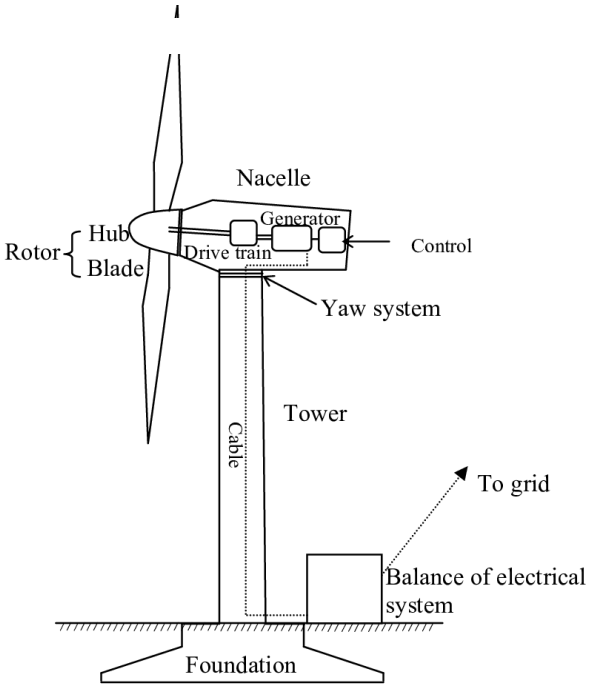
Disadvantages

1. Construction of a large tower is required to support heavy blades, gearbox, and generator.
2. The horizontal wind components of the air axis (gearbox, rotor shaft and brake assembly) are raised in place.
3. Their height makes them stand out from the crowd, distorting the appearance of the earth and sometimes creating local conflict.

Components of Horizontal-axis turbines

The basic components of Horizontal-axis turbines are as follows:

1. Foundation
2. Turbines
3. Nacelle
4. Generator
5. Rotor Blades



2. Vertical-axis turbines

Vertical axis wind turbines, as shortened to VAWTs, have the main rotor shaft arranged vertically. The main advantage of this arrangement is that the wind turbine does not need to be pointed into the wind. This is an advantage on sites where the wind direction is highly variable or has turbulent winds. With a vertical axis, the generator and other primary components can be placed near the ground, so the tower does not need to support it, also makes maintenance easier.

Benefits

1. Electricity can be produced in any direction
2. Strong supporting tower is not needed
3. Low production cost
4. Easy Installations
5. Low maintenance cost

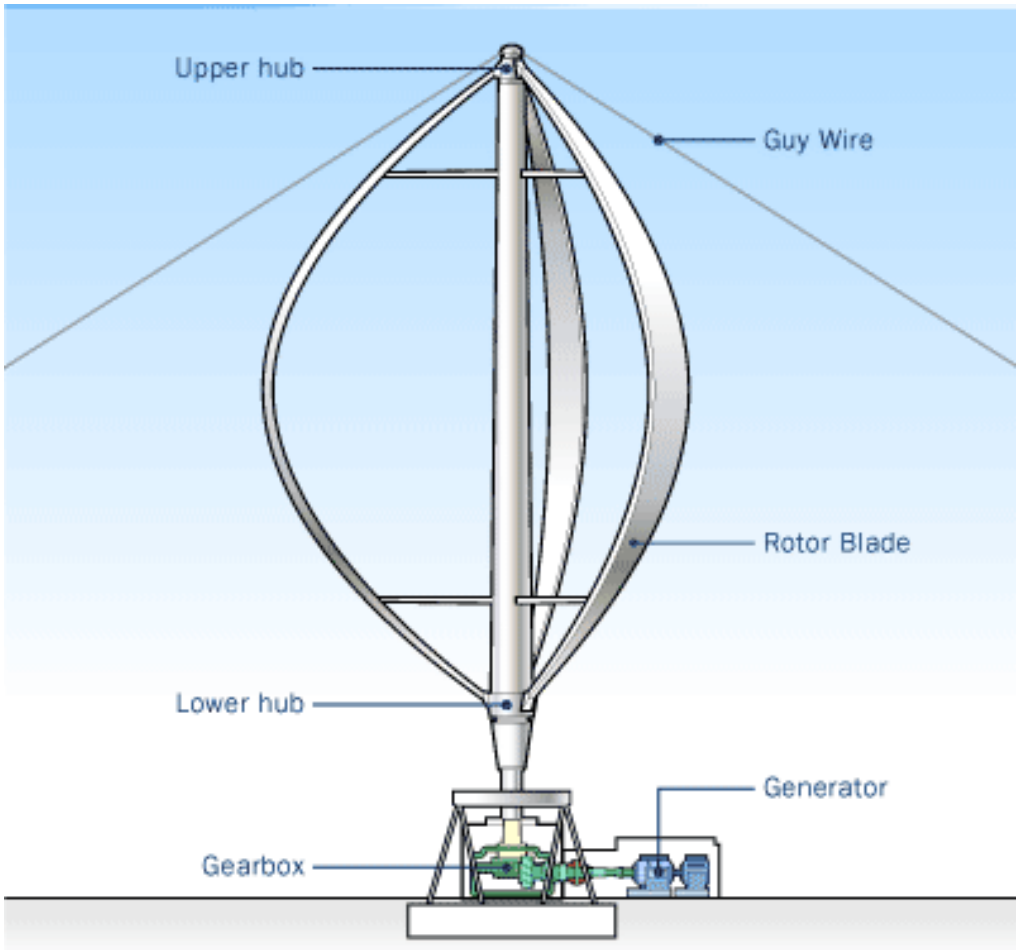
Disadvantages

1. Efficiency is low as compared to horizontal axis turbines
2. They need a initial push to start
3. They create noise pollution
4. They have relative high vibration

Components of Vertical-axis turbines

The basic components of Horizontal-axis turbines are as follows:

1. Guide wire
2. Hub
3. Rotor
4. Blades
5. Shaft
6. Brake
7. Gear
8. Generator
9. Base



Aerial Inspection of Wind Turbines

Aerial wind turbine inspection can be done in three steps

1. Collecting images from drones
2. Analyze images
3. Generate report

"Analysing" the collected images can either be done manually or automatically using cutting edge machine learning models. The task of manually looking at hundreds of high definition images is tedious and mundane which leaves it vulnerable to human errors.

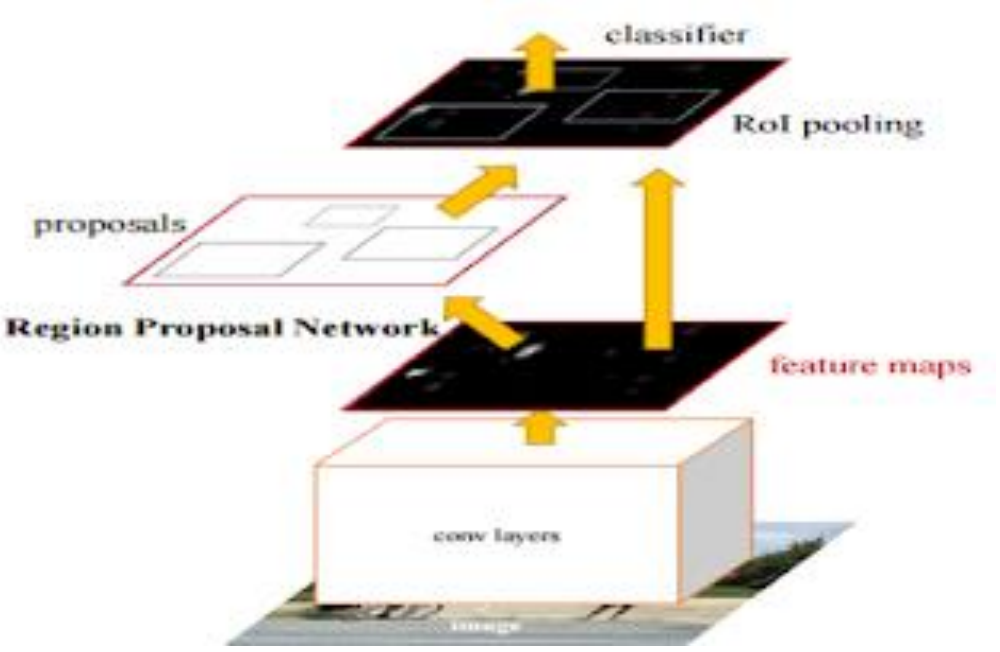
This step can be automated using Machine /deep learning steps. Some AI techniques can be used to analyse the image.

AI techniques that can be used in Aerial inspection of Wind Turbines can be :

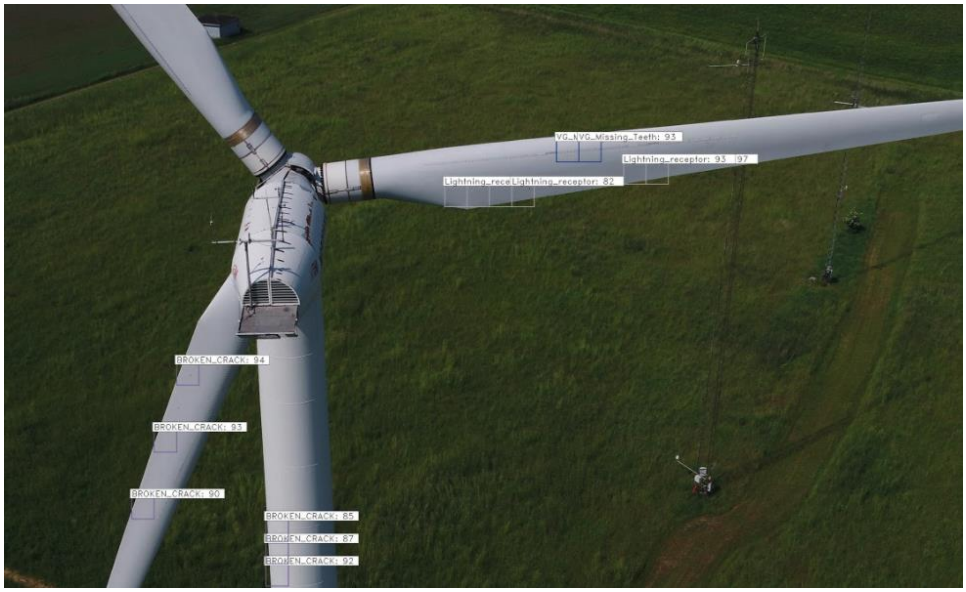
Faster R-CNN model:

Faster R-CNN is an updated version of R-CNN (and Fast R-CNN). The structure is similar to Fast R-CNN, but the proposal part is replaced by a ConvNet.

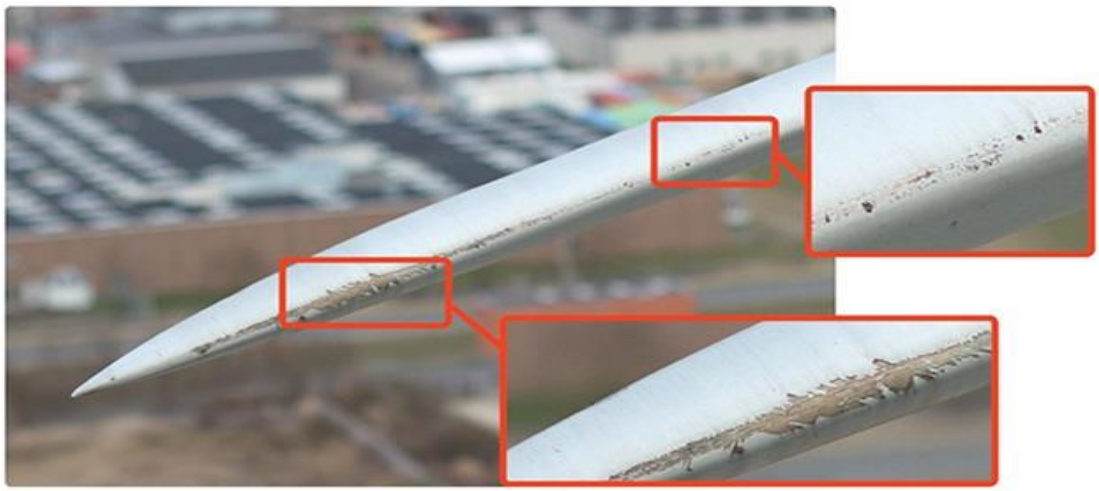
Faster R-CNN architecture



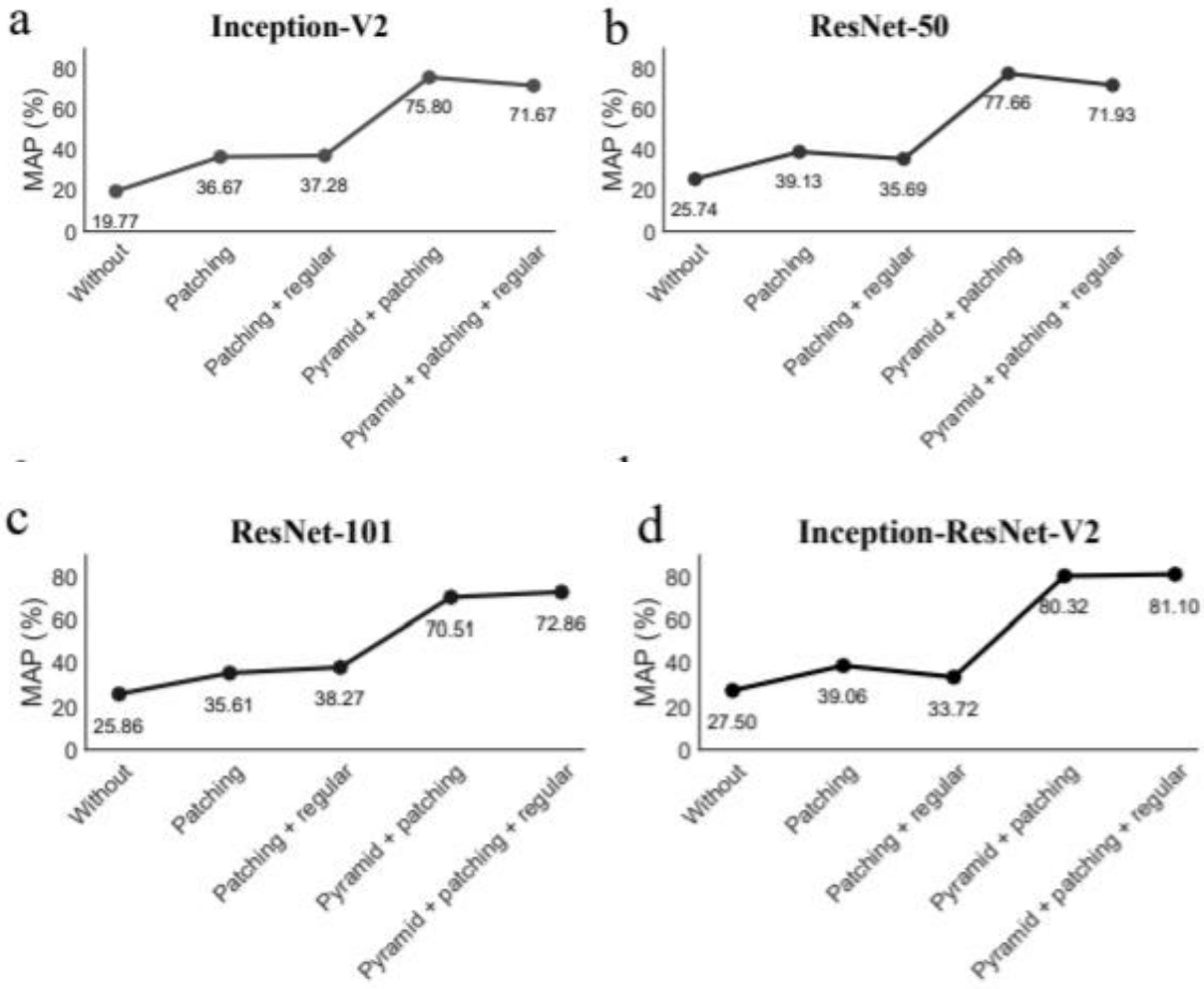
Examples of prediction through Faster R-CNN are as follows:



A drone inspection reveals damages to the wind turbine blade and ensures that repairs are carried out in time.



Experimental results for different CNN architectures and data augmentation methods:



Dataset for wind turbine inception

1 . DTU Drone Inspection Dataset:

It is the only public wind turbine drone inspection image dataset containing a total of 701 high-resolution images. This dataset contains temporal inspection images of 2017 and 2018 covering the “Nordtank” wind turbine located at DTU Wind Energy’s test site at Roskilde, Denmark.

Dataset Link - https://data.mendeley.com/datasets/hd96prn3nc/2

Faults in Wind Turbine:

The three wind turbines components that have the highest incident of failure are gearbox, generators, and rotor blades.

Rotor Blades:

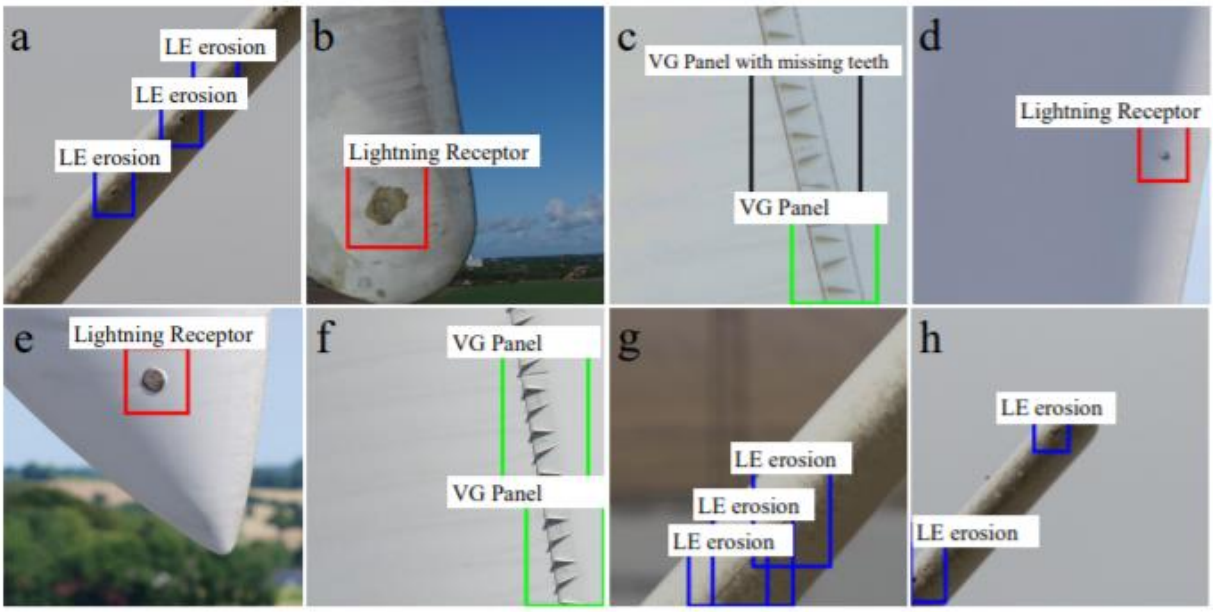
1. Skin/Adhesive Debonding
2. Adhesive joint failure
3. Splitting along fibres
4. Crakes in Gel coats
5. Leading Edge eroision

Generators:

1. Rotor Insulation Damage
2. Rotor Lead Vibration and/or head
3. Bearings – Thermal and vibration
4. Magnetic Wedges loosen

Gearbox:

1. Fretting
2. Micro Pitting
3. Fatigue Crakes
4. Material inclusion



Previous Demo of Aerial Inspection of Wind Turbine:

PROJECT DESCRIPTION

- Advanced Inspection of Wind Turbine Blades
- Wind Turbine Inspection in Wind Farms

External inspection of blades by vertical mapping, with high resolution RGB camera at close proximity for detail identification using artificial intelligence software.

Structural integrity report on blades, listing various observations:

1. Oil or local biology fouling
2. Condition of the coating layers
3. Spalling
4. Surface/deep cracks
5. Laminate cracking
6. Detachment of stringer
7. Damage due to weather conditions

LOCATION:

Ciudad Acuña, Coahuila.
Reynosa & Ciudad Victoria, Tamaulipas.

DURATION:

December 2020 to January 2021.

EQUIPMENT:

Phantom 4 pro V2
Matrice 210 RTK V2 + X5S