AI IN WIND TURBINES

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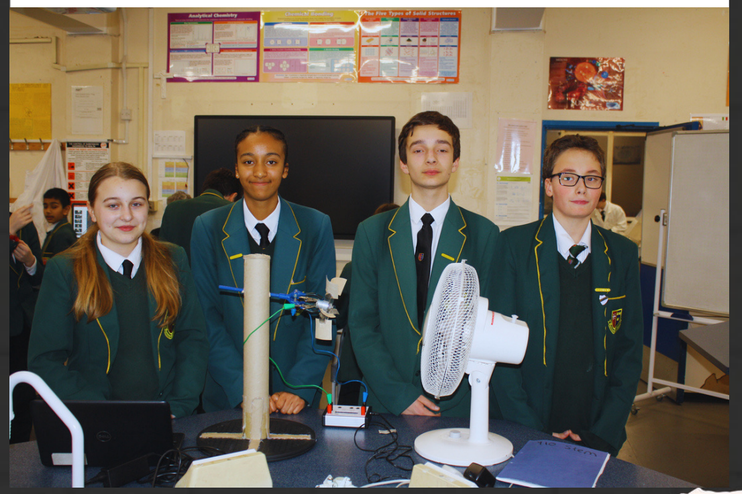


TALKING POINTS

- About our project
- Why Turbines?
- Objectives (and AI's role)
- Research
- Our Final Model!
- Results & data
- The Next Steps for AI

INTRODUCTION

Nowadays, the demand for eco-friendly energy resources has caused a lot of people to consider wind energy as a solution.

When the wind blows, it makes the blades spin around, which moves the turbine on the inside and generates electricity.

The generated electricity goes on to power things from appliances to entire cities!

OBJECTIVE 1

To make a working wind turbine model - Capable of lighting a light bulb

OBJECTIVE 2

To use the machine learning model (AI) to prove that wind-turbine usage time is linked to electricity outputted

OBJECTIVE 3

Our future applications - To be revealed!

RESEARCH: DESIGN

Initially, we advocated for the vertical axis wind turbine as we thought that its propellers could take in more wind energy, but it came with some disadvantages...

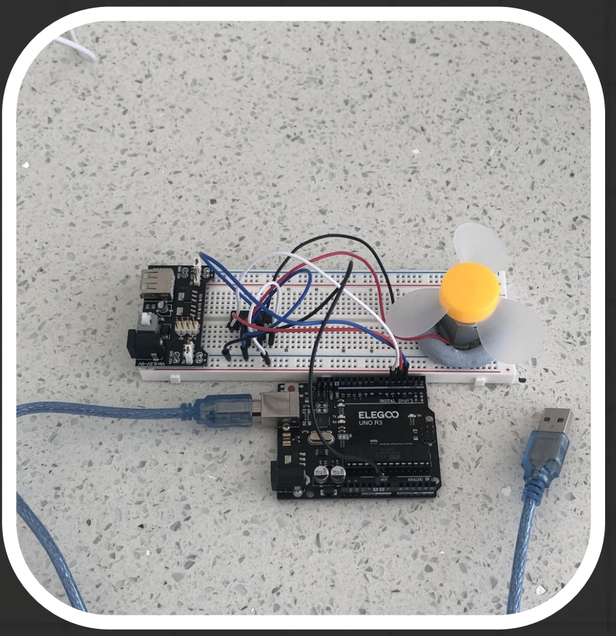
The vertical axis wind turbine is:

- Less efficient than a horizontal wind turbine, as the verticals have an efficiency ranging from 30-40% whereas the horizontals have an efficiency of 40% or more.
- This is supported by vertical propellers not being the most commonly seen models

RESEARCH:
BLADE SHAPE AND SIZE

We managed to investigate the properties of different types of propellers. As the propellers of the fan are very similar to a wind turbine, we analysed the propellers of fans we had at home to see which one was the most efficient.

For each fan, we measured the diameter of the base, the height and width of each propeller and the maximum distance you can put the fan.



We concluded that the fan in the middle was the most efficient with:

- 5 blades
- Each at a 45-degree angle.
- A base : height : width ratio of 3:2:2.

Research: materials for the wind turbine

For the propellers, we began with cardboard as it is a light material and we kept this the same as it is more cost-effective.

But in the end, we agreed that hard plastic material would be the best for a model, since it had to be:

- Durable
- Strong enough to carry the propellers that are of the same material as the base or lighter
- Waterproof if tested outdoors!

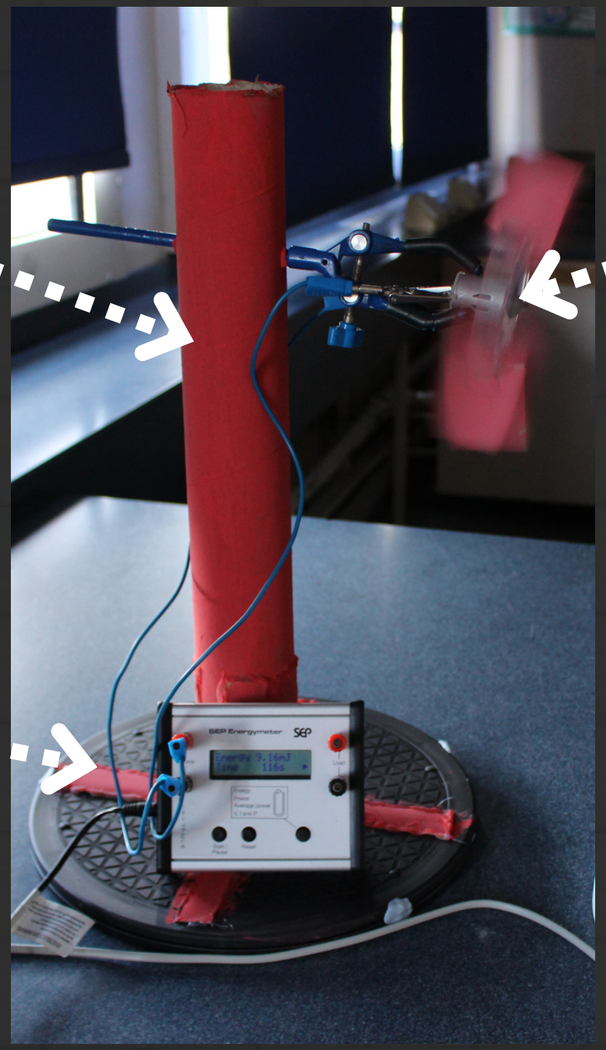
OUR FINAL DESIGN!

EQUIPMENT!

1. DC motor (x1)
2. A plastic lid 8.5cm (petri dish)
3. Small cardboard tubes (x4)
4. Long cardboard tube (x1)
5. Clamp (x1)
6. Glue gun (x1)
7. Washer (x1)
8. A Lazy Susan (x1)
9. Energy meter (x1)
10. Crocodile clips (x2)
11. Wires (x2)
12. Light bulb (x1)

Pole:

- Provides support to the wind turbine
- Adjusting the height can change the amount of wind exposure



Propellers:

- The blades of the wind turbine.
- With their curved shape, the wind turbine can gain a lot of kinetic energy from the wind.

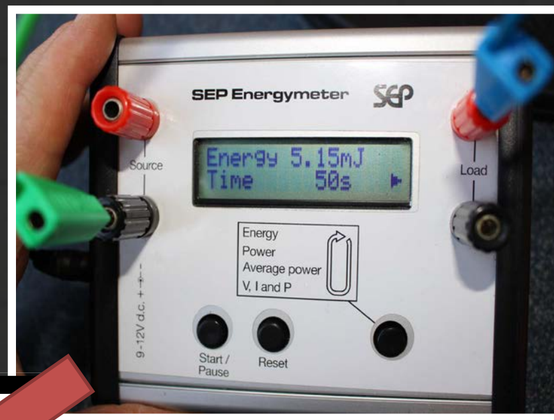
Base:

- The circular part that holds and carries the propellers.
- It is attached to a DC generator so it plays a role in enabling the whole turbine to spin and generate electricity.

About our project

We have programmed an energy prediction machine learning model using the coding language Python.

It takes historical data of the electricity generated by the wind turbine (via an energy meter), and predicts the energy output for any randomised time that the turbine works for.




```
import pandas as pd
import random
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error

# Function to generate random data for Attempt number, Energy, and Time
def generate_data(num_samples):
    attempt_numbers = list(range(1, num_samples + 1))
    energies = [random.uniform(0, 3) for _ in range(num_samples)]
    times = [random.randint(0, 100) for _ in range(num_samples)]
    return attempt_numbers, energies, times

# Number of samples in the dataset
num_samples = 100

# Generate the dataset
attempt_numbers, energies, times = generate_data(num_samples)

# Create a DataFrame
df = pd.DataFrame({'Attempt number': attempt_numbers, 'Energy': energies, 'Time': times})

# Print the generated numbers
print("Generated Attempt Numbers:", attempt_numbers)
print("Generated Energies:", energies)
print("Generated Times:", times)

# Splitting data into features and target variable
X = df[['Attempt number', 'Time']]
y = df['Energy']

# Splitting data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Creating and training a linear regression model
model = LinearRegression()
model.fit(X_train, y_train)

# Making predictions
y_pred = model.predict(X_test)

# Evaluating the model
mse = mean_squared_error(y_test, y_pred)
print("Mean Squared Error:", mse)

# Predicting energy production for new data
new_attempt_number = num_samples + 1
new_time = random.randint(0, 100)
new_prediction = model.predict([[new_attempt_number, new_time]])
print("Predicted energy production for new data - Attempt Number:", new_attempt_number, "Time:", new_time, "seconds   Prediction:", new_prediction,
"milli Joules")
```

```
Mean Squared Error: 1.0683859195993377
Predicted energy production for new data - Attempt Number: 101 Time: 78 seconds   Prediction: [1.3796841] milli Joules
```

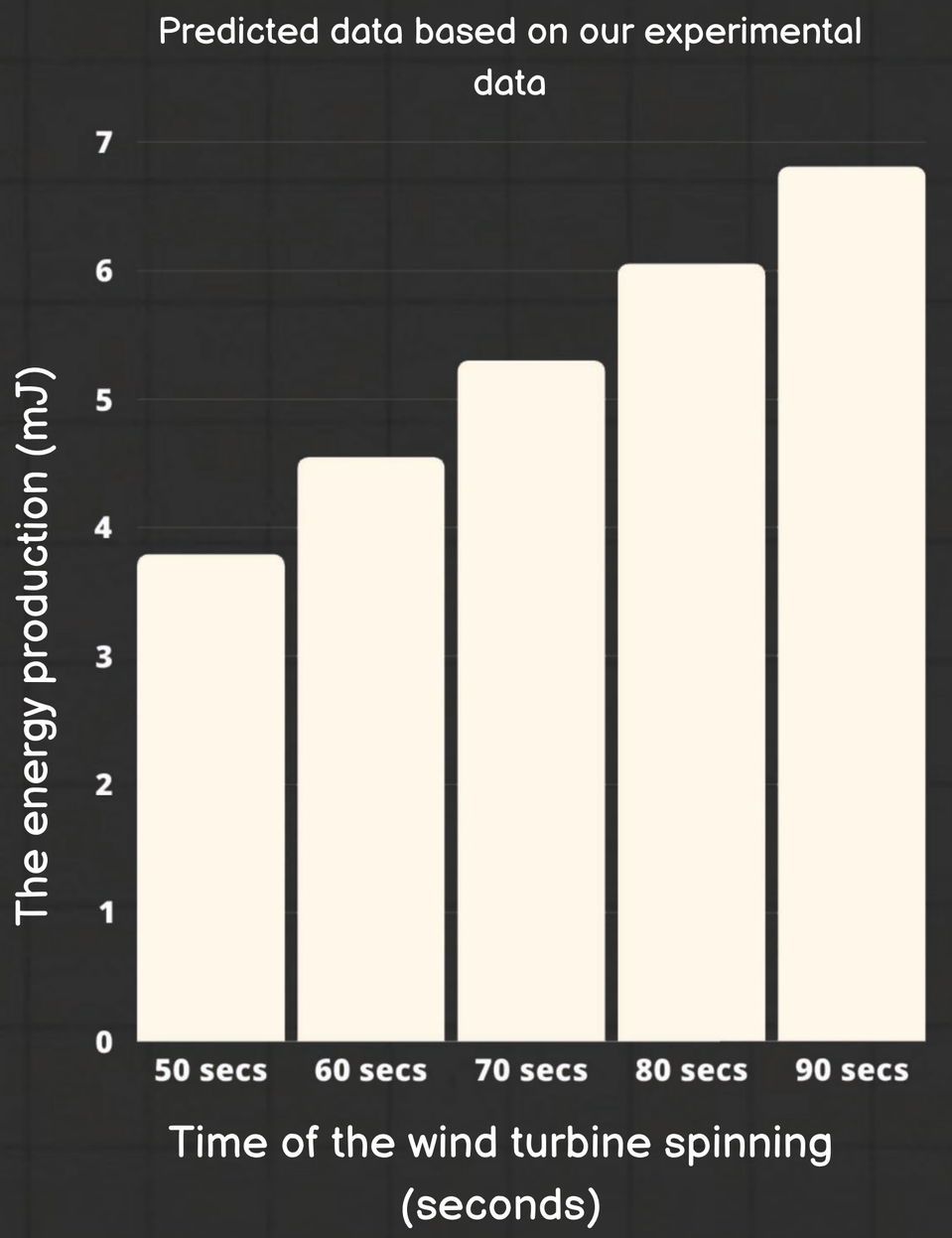
THE DATA

After inputting historical data into the machine learning model, we managed to gain a new set of predicted data.

The predictions matched our expectations!

From the predicted data:
"The longer the wind turbine is spinning, the more electricity generated"

This is because there is more energy is stored when the wind turbine spins for longer.



OUR NEXT STEPS!

With more time and research in the AI field, our goals are:

- To make AI models that predict how height, base width, Blade size and shape can affect the efficiency of a wind turbine

- This data could be shared with Energy companies to influence the next generation of wind turbines

POSSIBLE VARIABLES

INDEPENDENT

- The wind speed
- The wind direction
- The characteristics of the wind turbine
- The height of the wind turbine
- The air density
- Other climate conditions

DEPENDENT

- The electricity output
- The power output
- The efficiency
- The wind speed

THANK YOU!