A Real-Time Imaging System for Lumber Strength Prediction

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Abstract

In this report, I have presented the idea of using the Machine Learning and Deep Learning model, a model making technique to predict a number or any output based on the data given.

Though Machine Learning has been around for years, it's a technology whose time has come. More and more organizations are turning to ML to increase their bottom line and competitive advantage.
For sellers, it takes days to sell their woods so to overcome it our main objective is to use Deep Learning, which not only gives faster results but also demonstrates higher accuracy in the Cancer prediction process. In this report we have devised an optimal way to predict the price of Wood so as to get a glance about the prices and manage accounting accordingly.

1. Problem Statement

The Problem Statement is to make a Regression model to predict the price of wood for the sellers present in villages and shops. Although they have their own technique to predict the strength, that’s not accurate and they need a method to find the accurate price accordingly. In order to do so, I hope to create a service that can provide them with an accurate price which will lead to customer satisfaction and increase in sales.

2. Market/Customer/Business Need Assessment

The "Lumber Market" Size, Status and Market Insights, Lumber Market Report, published in 2022, offers a thorough analysis of the industry's state at the time. The study opens with a fundamental overview of the market, including terms, classifications, applications, market share, trends, forecast analysis, growth, manufacturers, industrial end users, commercial end users, governmental entities, and more.

There's a huge wood business in the whole country and our aim is to analyze and predict the price accordingly for the sellers.
With the growth of combining the concept of 'Big Data and Machine-Learning' and Introducing machine learning models for data analysis and the importance of data produced by the sales and sellers on a daily basis and how this data can be used by machine learning to tell the customer about the exact price of their whole wood bundle before selling it at the wrong price. This provides the customer with a better choice of wood based on the price predicted by the Machine-Learning model. The proposed system uses the sales dataset to make predictions for each wooden block purchased by the customer.

3. Target Specifications and Characterization (your customer characteristic)

- Our main objective is to sell our model to the NGO where sellers with the NGO can sell their woods.
- Also we will develop this model into an APP or Website so that the customer doesn't have to come all the time to buy.
- Price prediction will help individuals buy the type of wood and can use the robust model to analyze how good the quality is .
- Also, applying certain discount strategies on such grouped items will also increase the sales as required.
- This whole process suggests them with most bought, frequently bought wood which they can eventually consider for cultivation and hence, increase their sales as well.
- Predetermined dataset of wood sales and measurements is taken and based on that prediction is performed

4. External Search (online information sources/references/links)

The dataset can be found on the kaggle.

https://www.kaggle.com/datasets/edhenrivi/wood-samples?resource=download

The dataset consists of images and their labels. The sources of subsequent information is given below:

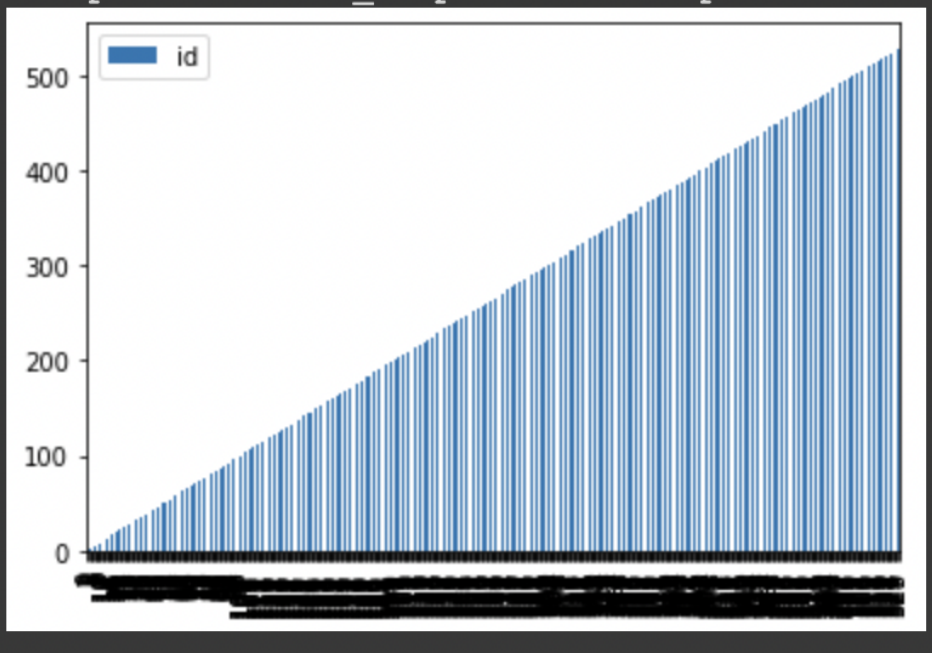
```
[1] import pandas as pd
    df = pd.read_csv('wood.csv')
```

```
[3] df.head()
```

	id	image	labels
0	0	abura-s-60x60.jpg	abura mitragyna ciliata
1	1	afrormosia-60x60.jpg	afrormosia pericopsis elata
2	2	afzelia-jh-60x60.jpg	afzelia afzelia spp
3	3	tree-of-heaven-44x60.jpg	ailanthus ailanthus altissima
4	4	tanga-tanga-s-30x60.jpg	albizia albizia ferruginea

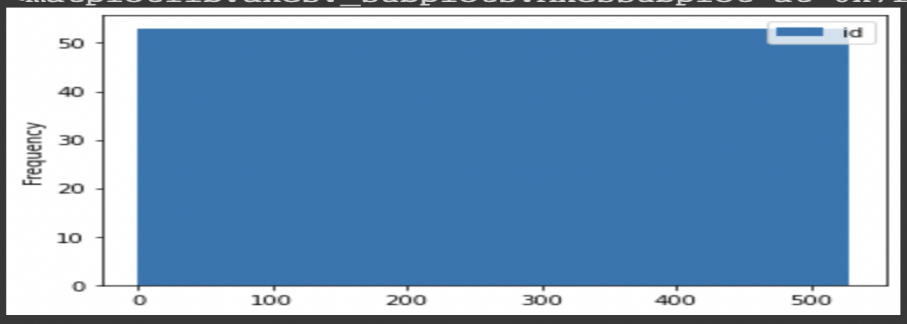
```
df.plot(kind="bar")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9726f46d9
```



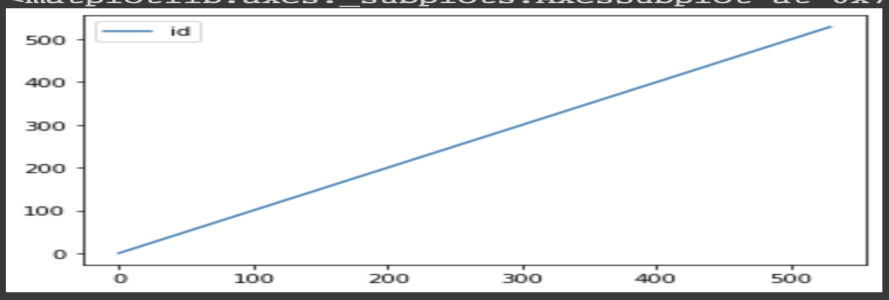

```
df.plot(kind="hist")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f972642e21
```




```
df.plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9725edb31
```



```
from PIL import Image

im = Image.open("/content/MyDrive/MyDrive/feynn/archive 2/images/images/abura-s-60x60.jpg")
im
```

```
[10] im = Image.open("/content/MyDrive/MyDrive/feynn/archive 2/images/images/african-mahogany-60x60.jpg")
     im
```

```
[12] im = Image.open("/content/MyDrive/MyDrive/feynn/archive 2/images/images/american-beech1-60x60.jpg")
     im
```

```
[13] df.info

<bound method DataFrame.info of       id                    image
0      0         abura-s-60x60.jpg                abura mitragyna ciliata
1      1      afrormosia-60x60.jpg             afrormosia pericopsis elata
2      2      afzelia-jh-60x60.jpg                    afzelia afzelia spp
3      3  tree-of-heaven-44x60.jpg           ailanthus ailanthus altissima
4      4   tanga-tanga-s-30x60.jpg              albizia albizia ferruginea
..   ...                       ...                                     ...
525  525     pacific-yew-44x60.jpg            pacific yew taxus brevifolia
526  526          zapote-60x60.jpg            chico zapote pouteria sapota
527  527       zebrawood-60x60.jpg  zebrawood microberlinia brazzavillensis
528  528        ziricote-60x60.jpg              ziricote cordia dodecandra
529  529    bois-de-rose-43x60.jpg         bois de rose dalbergia maritima

[530 rows x 3 columns]>
```

Other references are:
https://gov.capital/commodity/lumber/

https://tradingeconomics.com/commodity/lumber?fbclid=iwar066xsc6lo-dgf8sjs3ueqj9zixsy-zb1mer3pern2gaz0iv6tqa8xxy94#:~:text=Lumber%20is%20expected%20to%20trade,649.84%20in%2012%20months%20time.

https://www.nasdaq.com/market-activity/commodities/lbs

5. Bench marking alternate products (comparison with existing products/services)

Some of the companies or sites which are involved in making devices using different technologies like Forest2Market, tradingeconomics make use of these technologies for developing models which can also be used by small companies or start-ups to get an edge over bigger companies by working on root level and bring a huge change by developing more models.

Some of them are:

https://www.forest2market.com/forest-industry-analytics

: Forest2Market maintains the most current, robust and relevant set of analytical tools available to help members of the forest products industry better compete in today's global business environment. We leverage a series of customizable tools that combine the power of our transaction data, official data from government agencies and the strength of our supply chain expertise - nearly 400 years of combined experience.

https://tradingeconomics.com/commodity/lumber

: Lumber (USD/1000 board feet)

6. Applicable Patents (Patent of Tech/Software/Framework etc you are going to use in your Product/Service idea)

Some of the patents which can be applicable here whose goals overlap with our goals can be as follows –

1. https://patents.google.com/patent/US7680304B2/en

A technique for non-destructively inspecting a piece of wood that makes use of several sensors. The process may involve sensing the piece of wood, gathering data from the sensors, and incorporating that data into a physical model that predicts strength and stiffness. The information gathered relates to the wood piece's fibre quality qualities as well as its material characteristics. The wood piece's material characteristics may include one or more of the following: the thickness of the growth rings, the deviation of the grain from the straight line, the density of the clear wood, the location and density of knots, their types and sizes, and the location in the tree from which the wood piece was cut.
Microfibril angle, juvenile wood, biodeterioration, response wood species, manufacturing or drying faults including one or more of the following defects: sawcuts, checks, shake, size of real cross-section, and species are just a few examples of the fibre quality traits that could be present.

2. https://patents.google.com/patent/US20030093241

A technique for evaluating logs is revealed in order to forecast the structural characteristics and/or warp propensity of timber or veneer that could be made from a certain log. The technique can be applied online at a sawmill, at different points along the journey from the forest to the mill, in a merchandiser, sorting yard, or forest stand. It offers choices regarding whether a log should be sent to a sawmill for the production of lumber or for other uses like timbers, veneer, or pulp chips. It has been discovered that the log's taper correlates with the lumber's stiffness and tendency to warp. Lumber and veneer with a lot of taper will distort and have low rigidity.
To improve forecast accuracy, taper can be paired with other geometric characteristics of the log, such as sweep or cross section irregularity. This is easily achieved with a standard scanner at a sorting facility or sawmill.

7. Applicable Regulations (government and environmental regulations imposed by countries)

- Tracking Systems to Maintain Transparency
- Use Z-score function
- Data Protection
- User End-to-End protection
- Keep away from climate change (i.e. rain)

When subjected to long-term loading at high-stress ratios, many materials show a strength reducing effect. Wood is also inevitably influenced by this strength reducing effect during long-term service. This phenomenon is caused by the damage accumulation of wood that is related to the development of internal defects of the material

8. Applicable Constraints (need for space, budget, expertise)

- Lack of proper datasets.
- We can't predict by seeing just images, additional functionalities should also be there.
- Sometimes the output variable is problem.
- Image should be very clear.
- Technology dependent
- Model is always costlier, and it is based on deep learning so proce should be high.
- The model should work on maximum conditions applied.
- The pandemic wreaked havoc on the **lumber** market during 2021 as families fled urban areas in favor of finding homes in suburbia or rural areas.
- The spike in prices has also been reflected in the costs of home building and renovations
- The way **supply and demand** affect the pricing of commodities or merchandise.

9. Business Opportunity

From this, many startups want to grow their business and also this method gives the exact price so there's not any hesitation from the customer to buy it.
Many big companies want to optimize **wood** procurement **systems** – both volume and price and our model is best suited for them.
Due to the lack of market competition for this technology and the need for support, this is an issue that can also prove to be a profitable business venture. This opportunity, combined with a well-thought-out marketing plan, can help build a solid reputation in the market for assistive technology for the sellers.

10. Concept Generation (process of coming up with Idea)

So basically, I am currently working with an NGO where we are developing an app for the sellers in the village. The problem is that the sellers in village has no sources to sell their woods so we are with the villages NGO, helping the sellers to sell their woods by providing a medium through NGO i.e. an application, so whenever a customer have to buy a wood bundle, he/she buy from home with the accurate model price predictability and they didn't have to come for take things, all the items will be delivered by the sellers in the address provided.
Working with an NGO gives me a quick idea of how to work in a business like this, grabbing an opportunity, and being mentored towards a successful and entrepreneurship guidance career.
So this helps me to come up with an idea to make a lumber prediction model which will be a great business opportunity later on.

For developing an model, we'll performs several steps, they are:

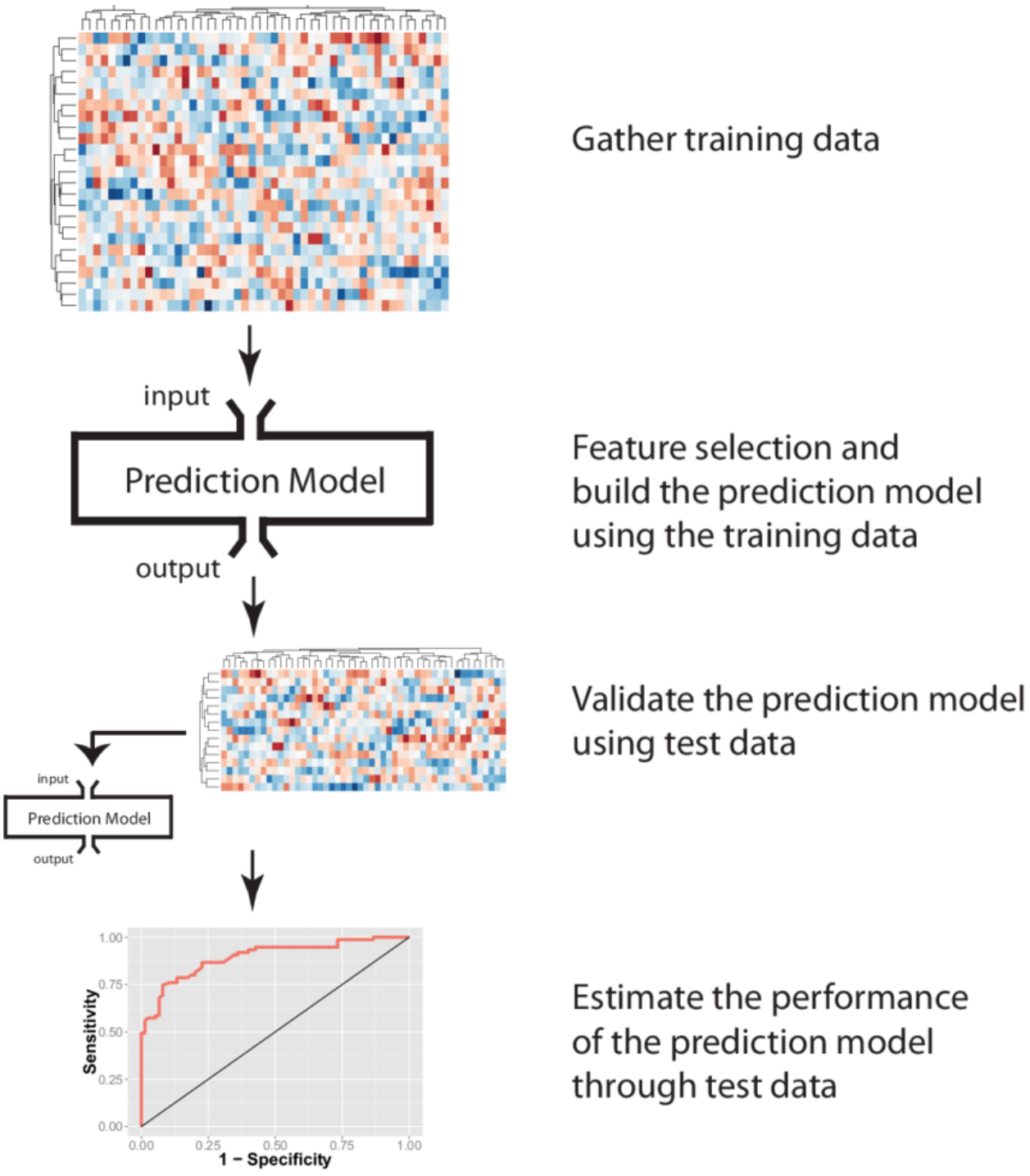
- Import the Dataset
- Load the Dataset
- Exploratory Data Analysis
    - Understanding the Dataset
    - Data Cleaning
        - Dropping duplicate values
        - Checking NULL values
        - Check for '0' values

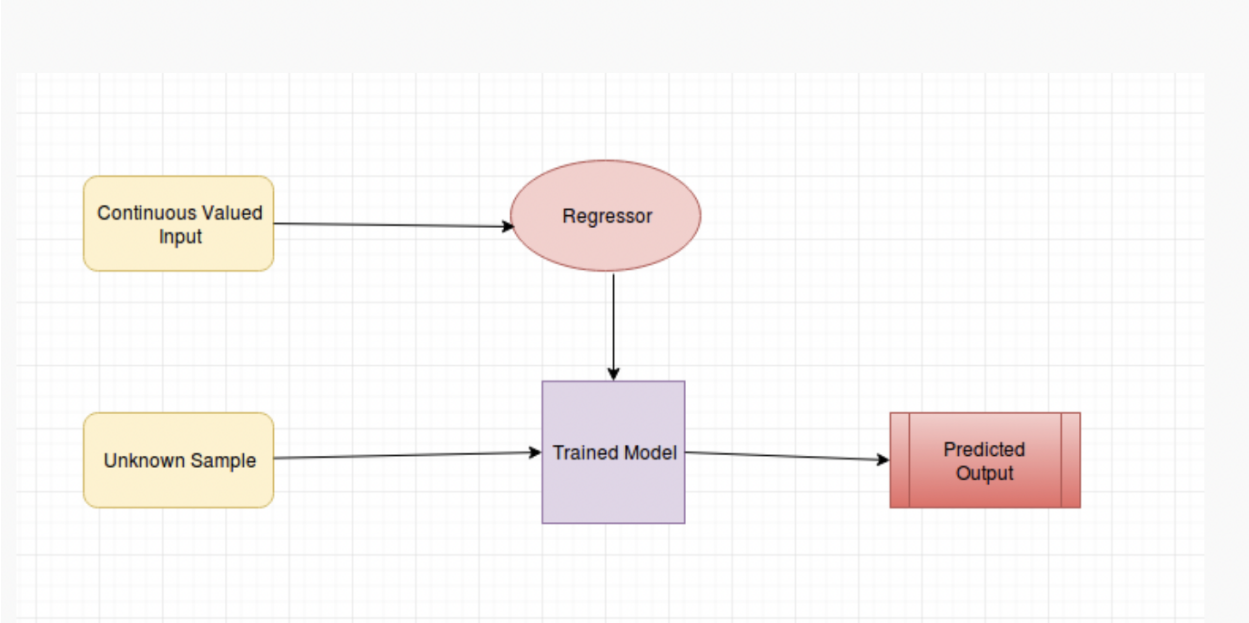
- Data Visualization
- Feature Selection
- Split the data into x and y
- Train Test Split
- Build the model by fitting and predicting it.
- Save and Deploy the model.

11. Concept Development (Brief summary of Product/Service will be developed)

This model is now ready to introduce to the world and we can do so by deploying in the application or a website.
So in backend the entire deep learning model is there which is going to predict the strength (price) of lumber and for the user we are creating a interface i.e. a web interface or an app interface by applying various frontend webpages languages and finally use of django framework to do it so easily.
Cloud services can be used based on requirements.

12. Final Product Prototype (abstract) with Schematic Diagram





Back-end:
1.Working with lots of dependent and independent data.
2.Optimise the accuracy using various machine learning algorithms.
3.Tuning in such a way that the model can't undergo overfitting.
Front-end:
1.Design the front-end part according to organization need.
2.Send data to the backend and display the result.
3.Feedback system may also present.

Github Link : https://github.com/nikhill21/feynn_Task1

13. Product details

How does it work?

This product is going to predict the price of lumber based on your entries. You are providing us some input and based on the previous data we have, we are going to predict for the new entry.

Data Sources

I found the dataset on kaggle.com, also a machine repository for some great dataset to work on.

Algorithms, frameworks, software etc. needed

- Django
- BootStrap
- Regression algorithm
- Sequential Deep learning model
- Mobile application development
- Google colab or Jupyter notebook

Team required to develop

Need a member who has knowledge on maintaining the site, a tester, developer and a deep learning expert. So basically 5 members in a team.

What does it cost? etc

For the bare minimum required to deploy and maintain an ML model, we can expect to spend **around $60K over the first five years** for that model.

14. Conclusion

More and more big brands are discovering ways of using lumber prediction technique to gain useful insights into associations and hidden relationships. But this extension for Small businesses is a great opportunity to improve sales and help these businesses grow. I have hence proposed the application of this technique for the sellers having an issue with selling the lumber bundles. This is not a full fledged plan, but with a considerable amount of work and effort, it seems achievable.

Github Link : https://github.com/nikhill21/feynn_Task1