PREDICTIVE MAINTENANCE FOR ELEVATORS

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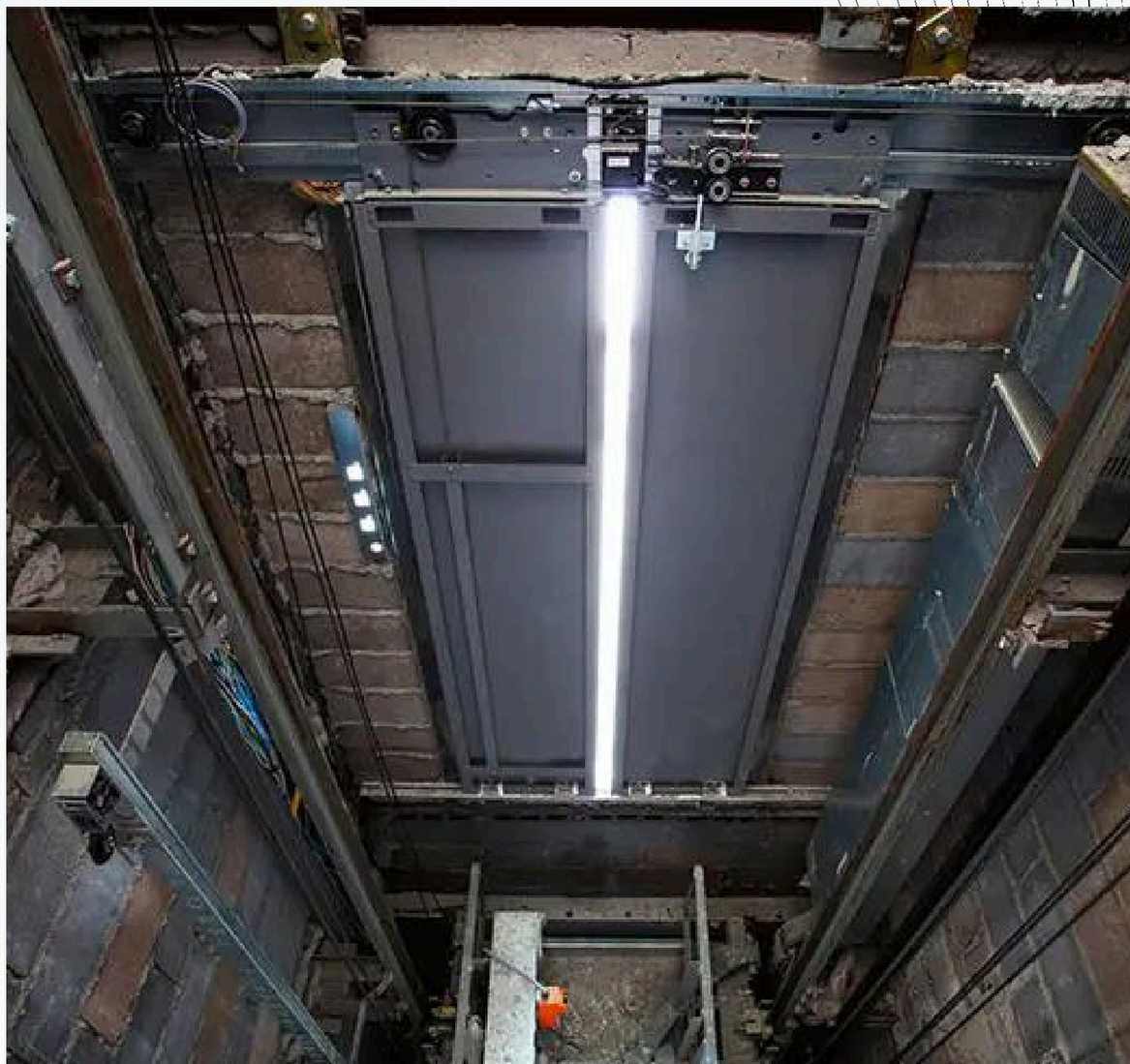
PROJECT DESCRIPTION

- Elevators are widely used and have 2 main points of failure, the door bearings and operational failures. They are mainly maintained in intervals or when fault occurs which can lead to bad experience and worse permanent damages.

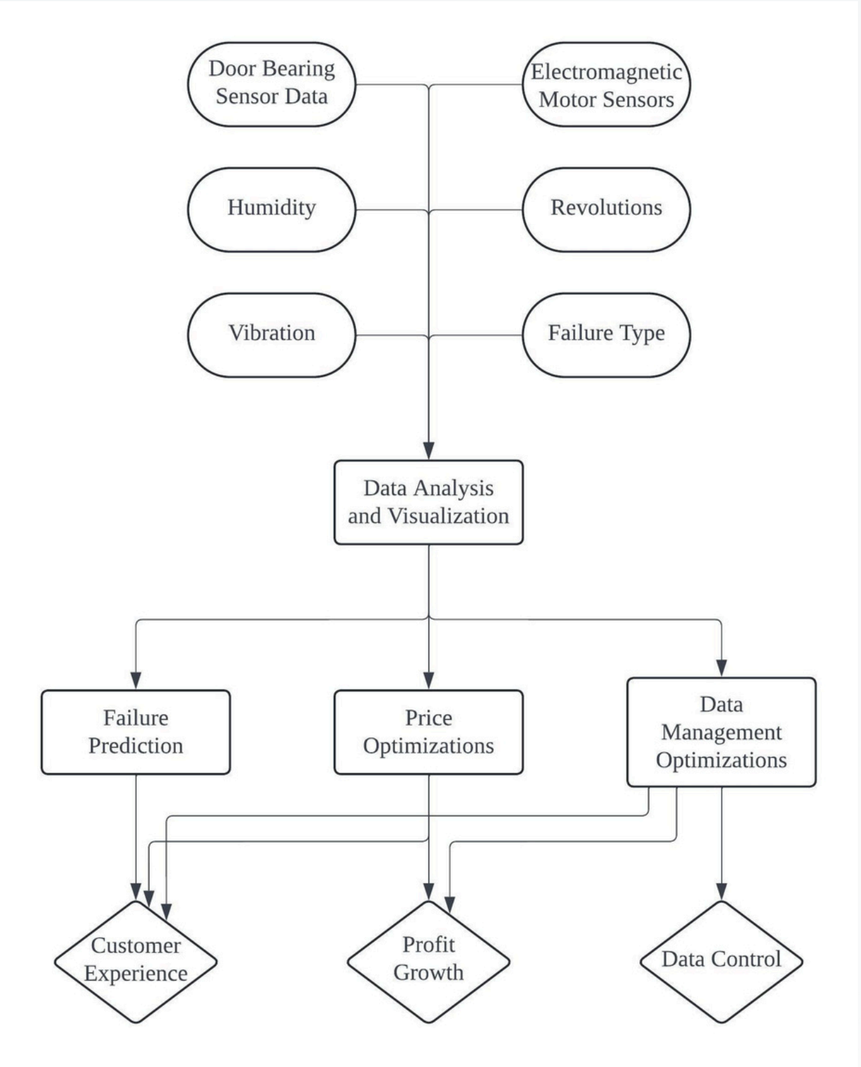
- This project uses sensor readings to predict failure of door bearings and estimate the vibration of the elevator and check if the elevator requires proactive maintenance.



BUSINESS MODEL

Model

- The application will be sold as Software As A Service (SAAS)
- The model will be trained using data gathered from elevator manufacturers and open data.
- The main benefits would be reducing downtime by only doing maintenance when required, reducing costs and also greatly improving user experiences in the standard of the establishment.



DATASETS AND CHARACTERISTICS

2 Main Datasets were selected for analysis.

- Dataset by Mr Wild (2023) for the sensor readings for predicting elevator door failure based on the available data of failure records collected from various sensor outputs.

- Dataset by Bansal (2022) from the Huawei German Research Center for the operation data, for absolute vibration and electromechanical sensor readings at peak evening elevator usage.

Volume

A large number of sensor readings and inflow of data.

Velocity

Large Real-Time Streams of Data.

Variety

Multiple different Types of Sensor Data

Veracity

Accuracy of the sensor data and results.

PLATFORMS AND TOOLS

- Data was preprocessed, and independent and incorrect/empty fields were removed during the cleaning and wrangling of the data.
- The datasets were split into training and testing data using a 4:1 split using R and Rstudio to reduce overfitting.
- Data analysis, model creation and Visualisation were also done using R and packages.
- Datasets for the tests were read from CSV format but as the volume is increased would transition to SQL and use databases like PostgreSQL.

ANALYSIS OF DATA

Door Bearing Failure Prediction Model

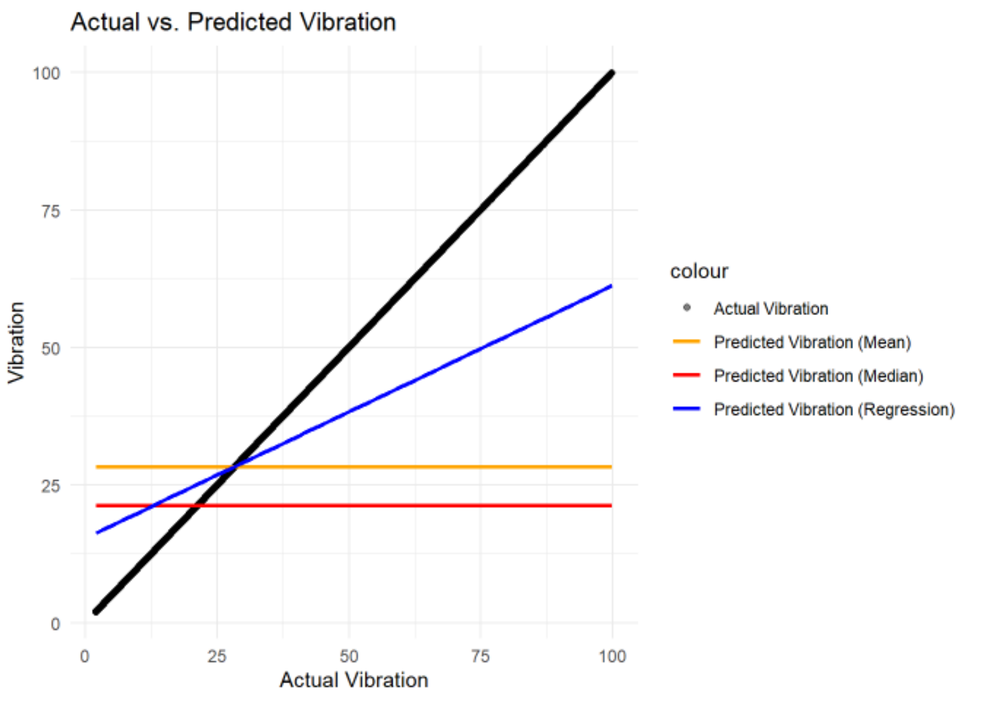
```
##              pred_gini_test
##               failure no failure
##   failure          13          7
##   no failure        3       3979
```

```
##              pred_entropy_test
##               failure no failure
##   failure          16          4
##   no failure        4       3978
```

- Classification Tree Model was selected for the prediction model of the door failure data, and both Gini and Entropy tests were tested.
- Gini and Entropy both had a outcome prediction accuracy of 99% but when it came to failure prediction, Entropy had a 80% accuracy while Gini only had 65%.
- Therefore for the final model Entropy split classification model was used for prediction of the door bearing failure.

ANALYSIS OF DATA

Vibration Prediction Model



- The regression Tree Model was selected for the prediction model of the absolute vibration, and 2 extra baseline models using mean and median were used as comparisons.
- The Regression model had a 50% lower Mean Square Error (MSE) compared to the baseline models which proves a significant improvement in the accuracy of predicted vibration values.
- This is also shown by the lines in the chart for predicted vibration for all models.

STANDARDS, DATA GOVERNANCE AND MANAGEMENT

Standard

The Chosen standard that we have followed is CRISP-DM (Cross-Industry Standard Process for Data Mining), including the steps of Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation of Model and Deployment.

Data Management

- All Data is cleaned to remove incorrect entries.
- Follow strict field and file naming.
- All this ensures good policies, practices and data quality and proper handling of the data throughout the project development.

Data Governance

- Ethics and confidentiality.
- Security and policies.
- Backups and Recoverability.
- All this ensures that the data management process is done appropriately.

HAVE ANY QUESTIONS?

Mr. Wild. (2023). Failure prediction of elevator component [Data set]. Kaggle. https://www.kaggle.com/datasets/mrwild/failure-prediction-of-elevator-component.

Bansal, S. (2022). Elevator predictive maintenance dataset [Data set]. Kaggle. https://www.kaggle.com/datasets/shivamb/elevator-predictive-maintenance-dataset.