Transformer Trip

PROJECT

December 25, 2018

Outline I

Project Brief

- Business Objective : To classify the root causes of transformer trip and identify the strong parameters which are associated with transformer tripping.
- Assumption :
  110KV/220V rating transformer
  75% of total cases results in tripping

Outline I

Input parameters

- Input voltage : measured in volts, input supply in residential areas is 220V, tripping occurs above 230V
- Age : the average life length of transformers is about 25
- Oil temperature : maximum permissible temperature is 105°C.
- Winding temperature : maximum permissible temperature is 105°C.
- Ambient temperature : average temperature is 32-40°C and can tolerate upto 50°C.
- Over loading : Tolerance upto 288.67 amps of loads.

Input Parameters

- Bushing/winding HV : 120mm with tolerance -5% to +10%
- Bushing/winding LV : 20mm with tolerance -2.5% to +5%
- Moisture content : The water content in oil is allowed up to 50 ppm as recommended by IS335(1993)
- Oil level : should be 90% at loading of 70% of transformer
- Core flux density : maximum permissible is 1.55 Tesla
- Climatic factor : Lightening and thunder strikes

Output Variables

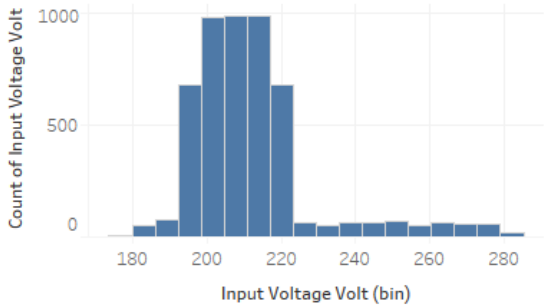
TRIPPING CAUSES :

- Insulation degradation
- Tap changer failure
- Core failure
- Winding failure
- Bushing failure
- Tank failure
- Overloading
- Excess moisture
- Climatic conditions

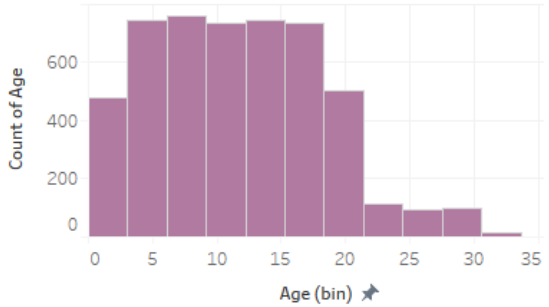

EXPLORATORY
DATA ANALYSIS

Visualizations

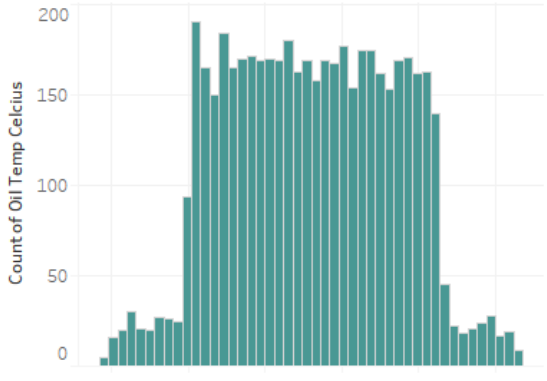
Input Voltage volt



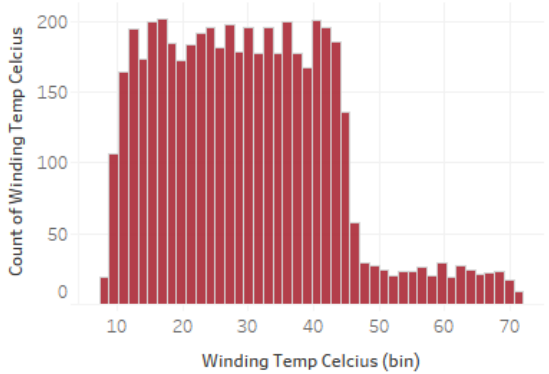
Age



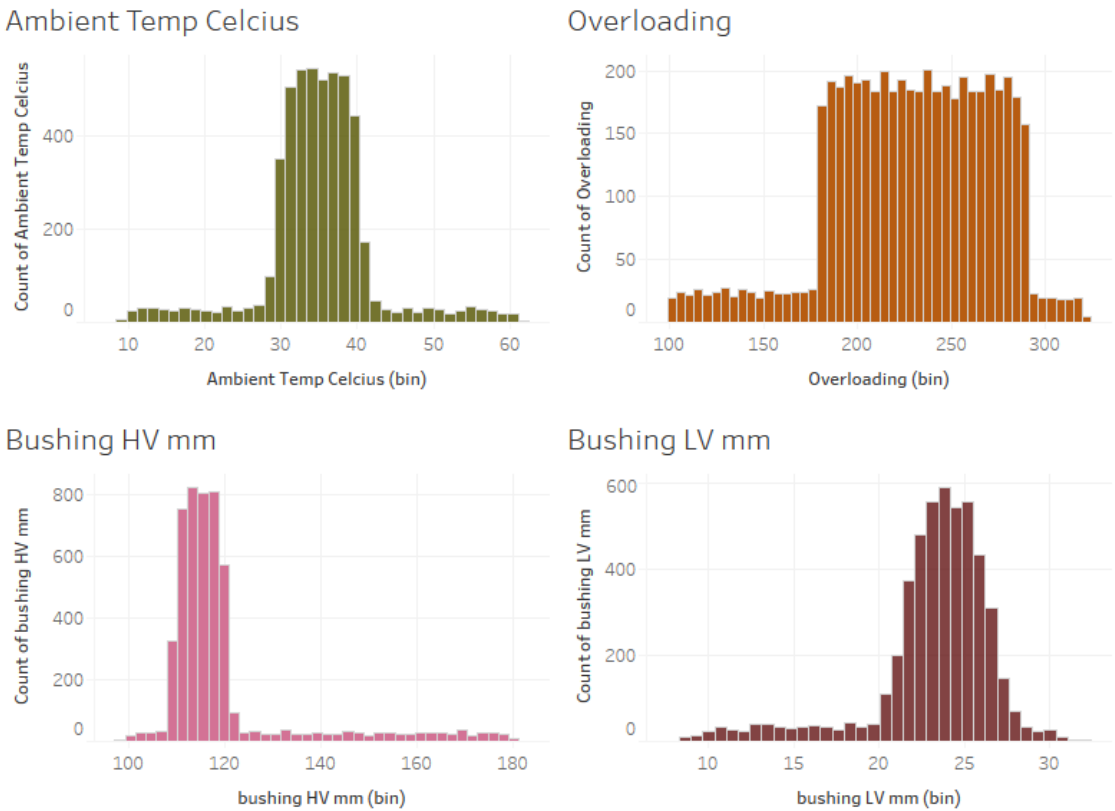
Oil Temp Celcius



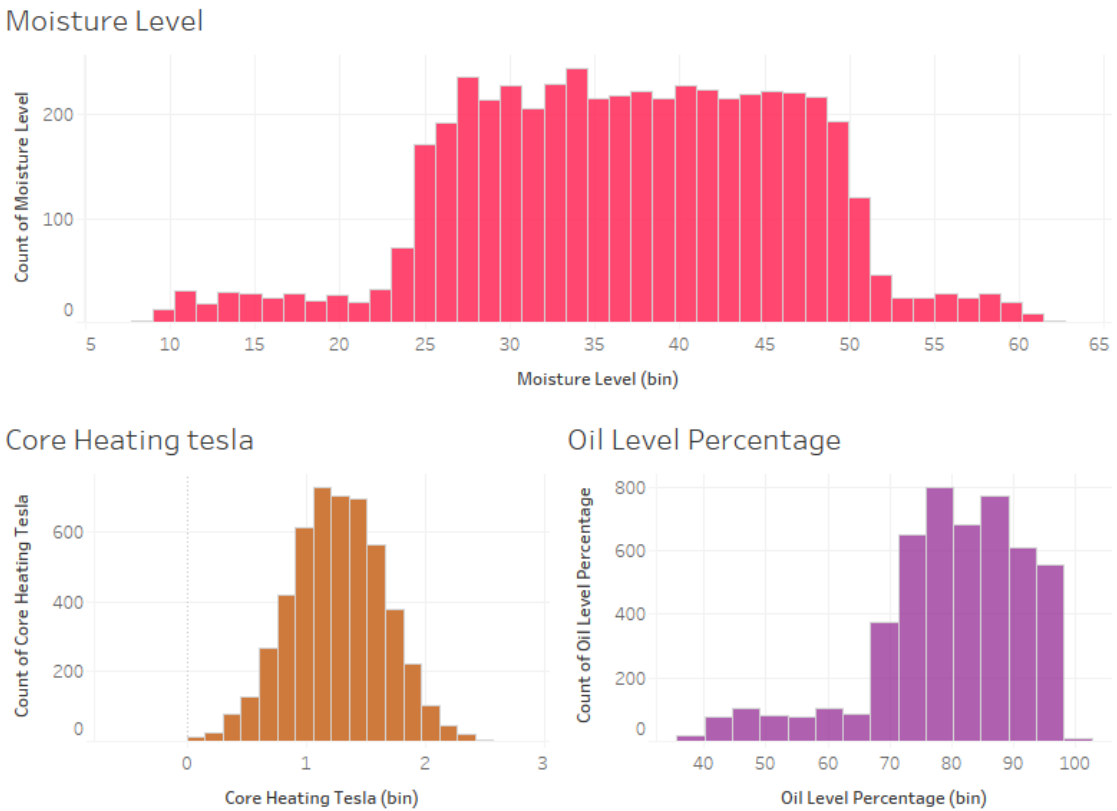
Winding Temp Celcius



Visualizations



Visualizations



Outline I

Algorithms

CLASSIFICATION

- Decision Tree
- Random Forest
- Näive Bayes
- Support Vector Machine
- k-Nearest Neighbours

Model Accuracy

Model	Accuracy
Decision Tree - c5.0	98.56
Random Forest	99.36
Näive Bayes	77
SVM (rbf)	89.84
kNN(k=5)	75.1
Logistic Regression	84.4

Table: Model Accuracies

Variable importance - RF

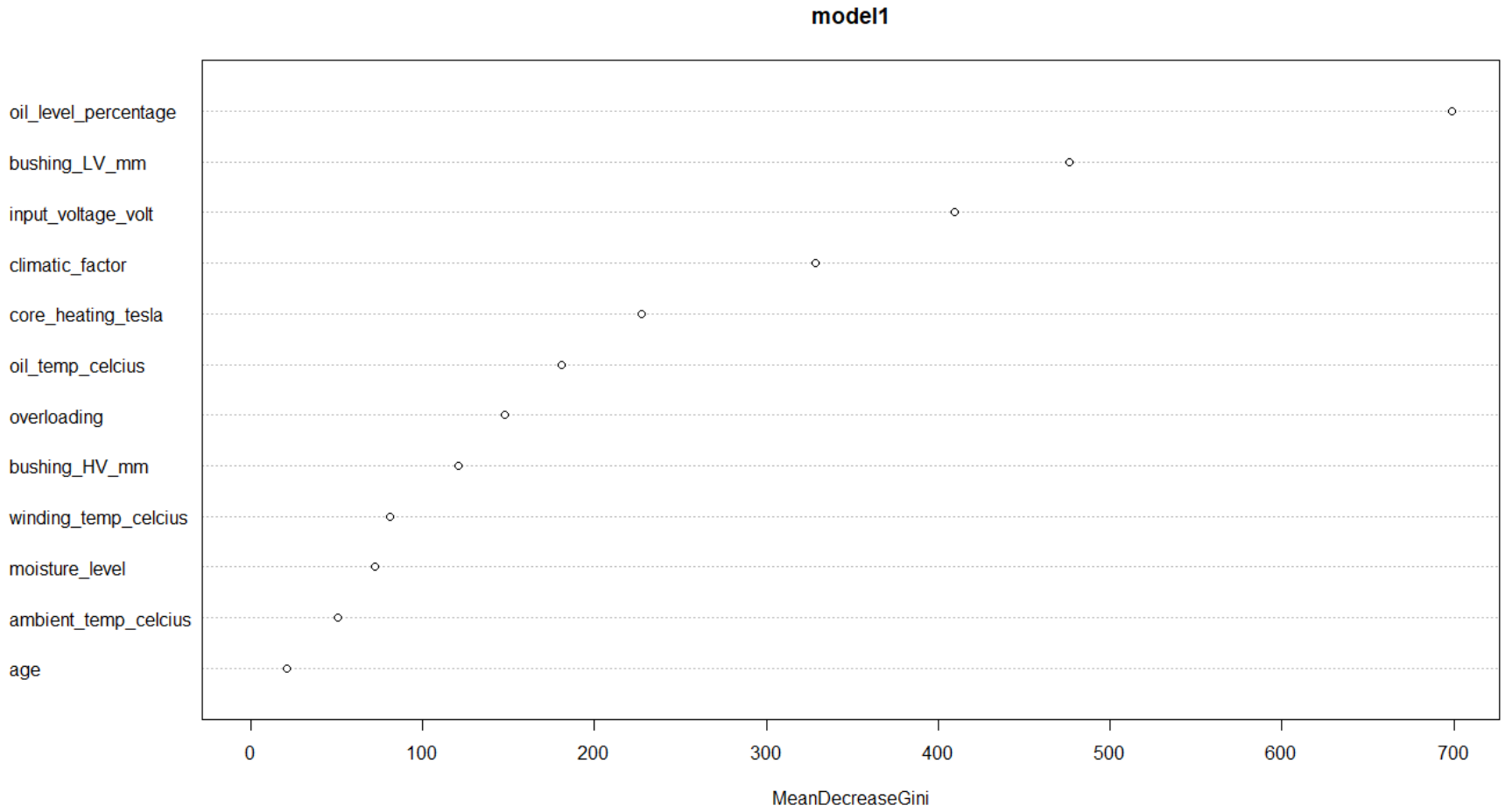


Figure: Dotchart of variable importance as measured by Random Forest

Predicted probabilities - tripping cause

Cause	Percentage
Tank failure	21.44
Insulation degradation	12.41
Bushing failure	11.76
Core failure	10
Climatic condition	8.16

Table: Predicted % of Occurances

- Tank failure, Insulation degradation, Bushing failure and Core failure are found to be the most prominent root causes for tripping.

Evaluating Model for new data

input_volt	age	oil_temp_	winding_t	ambient_t	overloadi	bushing_H	bushing_L	moisture_	core_heat	climatic_f	oil_level_
208	16	104.26	27.61	39.39	184.54	119.12	23.76	39.93	1.57	no	87
197	17	87.84	10.47	35.6	232.86	116.28	23.1	27.64	1.39	no	76
196	9	73.23	25.3	29.3	282.32	111.52	24.59	26.27	1.47	no	98
204	7	51.87	9.36	30.45	274.23	113.12	24.6	35.26	1.21	no	80
205	13	101.63	22.71	37.07	181.11	115.77	23.86	33.77	2.25	no	82
195	15	100.02	15.3	37.66	217.47	115.86	21.54	23.61	1.51	no	79
203	18	58.14	29.26	36.07	194.58	118.01	20.75	35.33	1.89	no	88
203	12	100.5	39.93	35.77	282.66	115.09	23.13	33.87	1.05	no	92
202	8	92.45	40.18	39.79	287.35	118.63	22.94	32.1	1.21	no	87
197	18	65.44	19.02	32.47	227.45	114.88	21.93	25.5	0.82	no	95
217	5	77.36	29.33	34.37	255.88	114.73	25.15	48.49	1.53	no	85
205	4	73.67	32.33	31.16	264.45	110.76	20.75	33.01	1.4	no	83
215	3	55.62	40.89	32.69	278.17	111.39	24.92	42.73	1.51	yes	85
210	13	63.4	40.23	30.95	199.02	112.21	25.74	41.78	1.19	yes	88
198	6	55.57	42.37	31.99	280.85	112.18	24.62	29.56	1.07	no	86

Prediction using RF

Observation	Predicted Cause
1	No
2	Tank failure
3	No
4	No
5	Core failure
6	Tank failure
7	Core failure
8	No
9	No
10	No
11	No
12	No
13	Climatic Condition
14	Climatic condition
15	No

Table: Predicted Causes

Business Benefits

- By using this model we can identify and predict the root cause of each transformer trip.
- The main advantage would be to check for any possibilities of tripping in advance in a particular transformer, so it can be solved even before the tripping takes place.

Conclusion

- After research and observation of the several parameters of a transformer, we have selected a few prominent input parameters and its permissible values above which tripping occurs.
- After data simulation, we have applied different machine learning algorithms and found out that 'RandomForest' algorithm gave us the best accuracies for classifying the causes for tripping in transformers.
- The model so built can now be used to identify the causes of transformer trip.

THANK YOU