

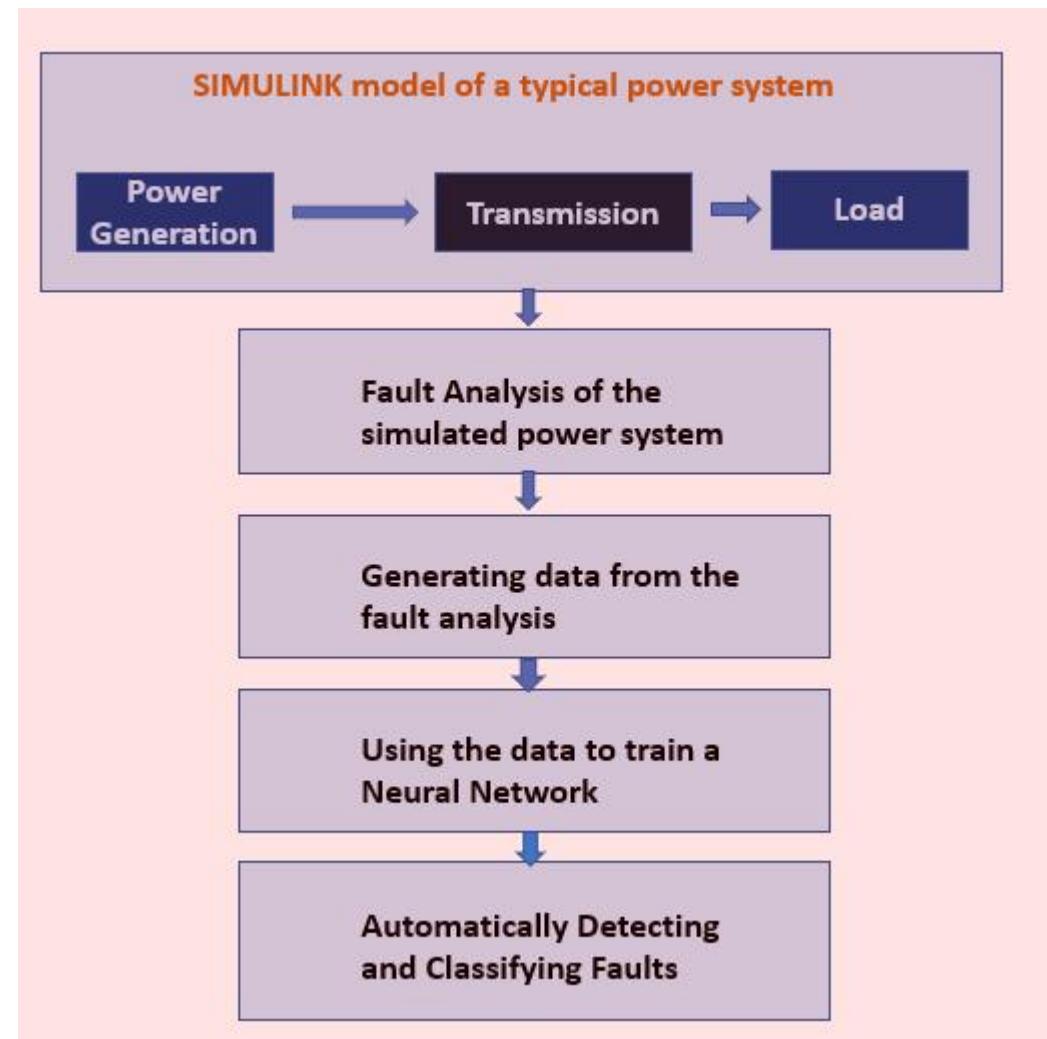
Electrical Fault Generation and Classification in the Northern Region of Bangladesh



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Initial Planning



Types of Faults in Transmission Line

- Common reasons for fault occurrence

- Lightning
- Wind
- Manufacturing defects

- Types of electrical faults

- **LLL - Line-Line-Line fault**

Three-Phase fault where all three lines are faulted

- **LG - Line-to-Ground fault**

Fault where one line comes into contact with the ground

- **LL - Line-to-Line fault**

Fault where two lines come into contact with each other

- **LLG - Line-to-Line-to-Ground fault**

Fault where two lines come into contact with each other and also with the ground



Fault Detection and Classification Techniques

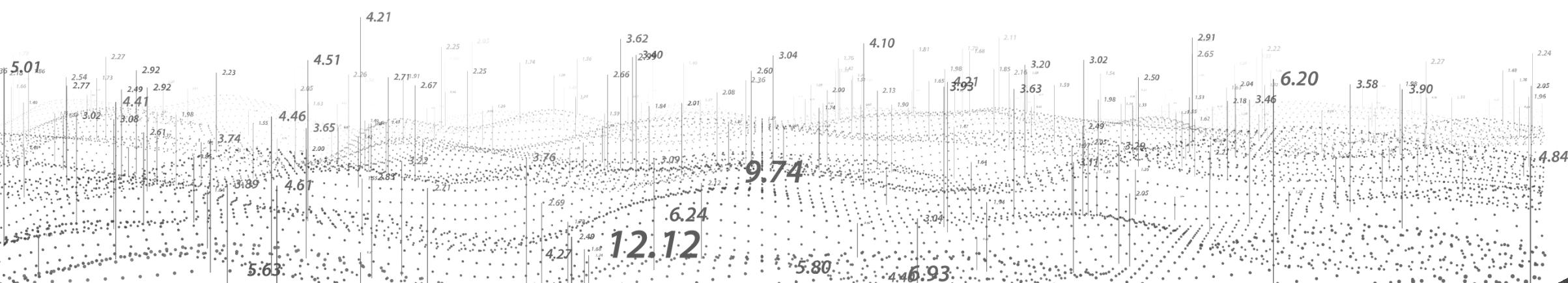


Traditional methods

- Overcurrent relays
- Differential relays
- Distance relays

Advanced methods

- Machine learning
- Deep learning



Study Area

The Northern Region of Bangladesh

- Fault Analysis in the Northern Region of Bangladesh.
- Focus on the north region of Bangladesh for fault analysis.
- Total **35 buses** in the region

MATLAB Simulink model development with



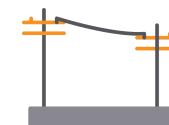
35
buses



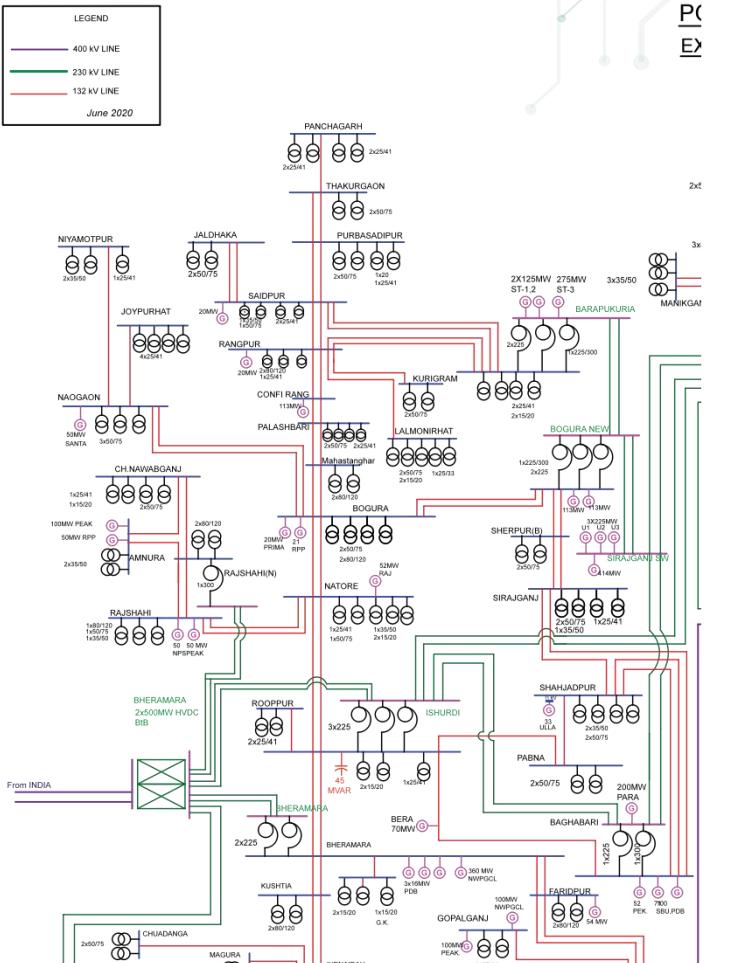
30
generators



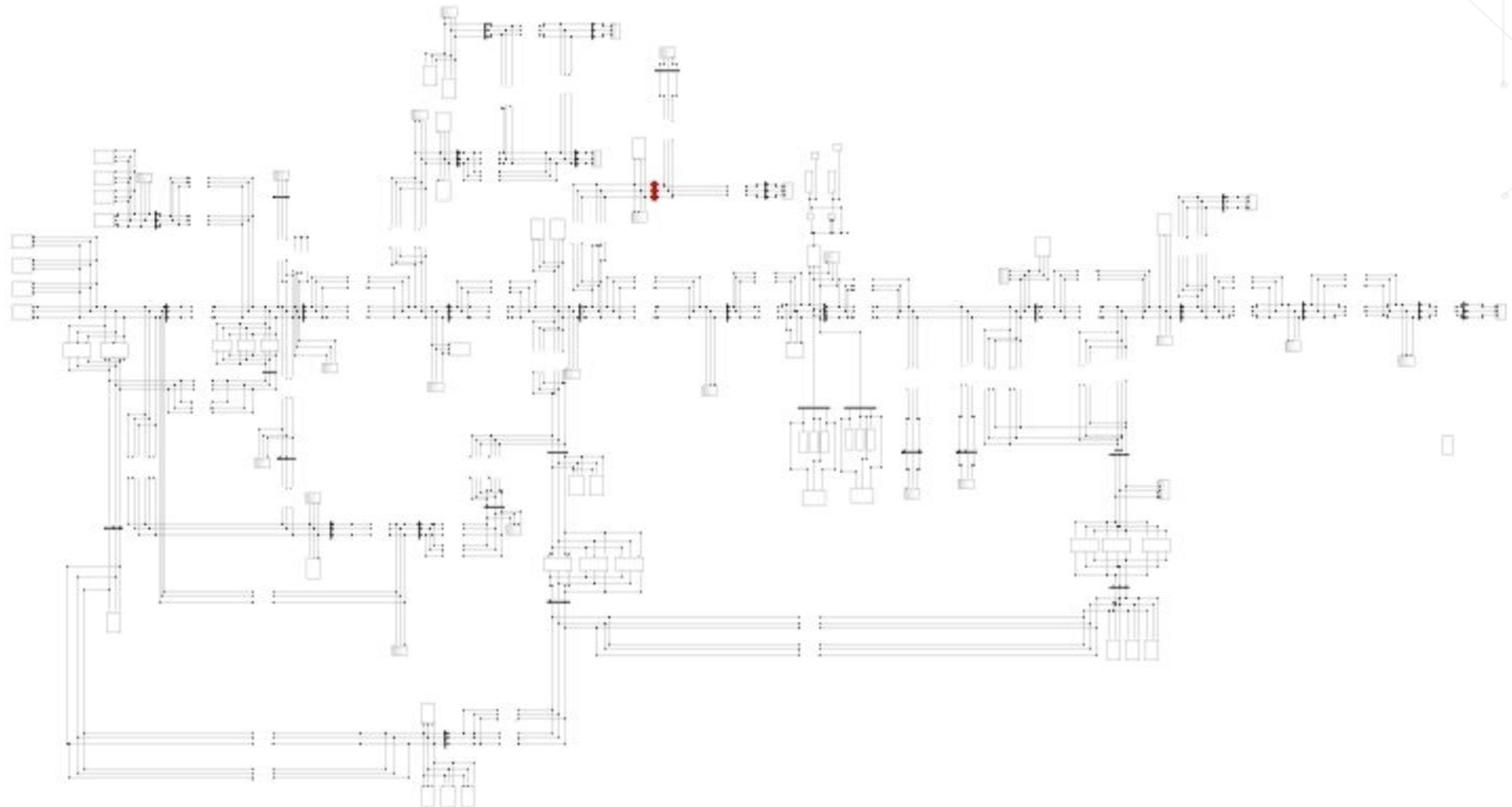
94
transformers



Transmission
line

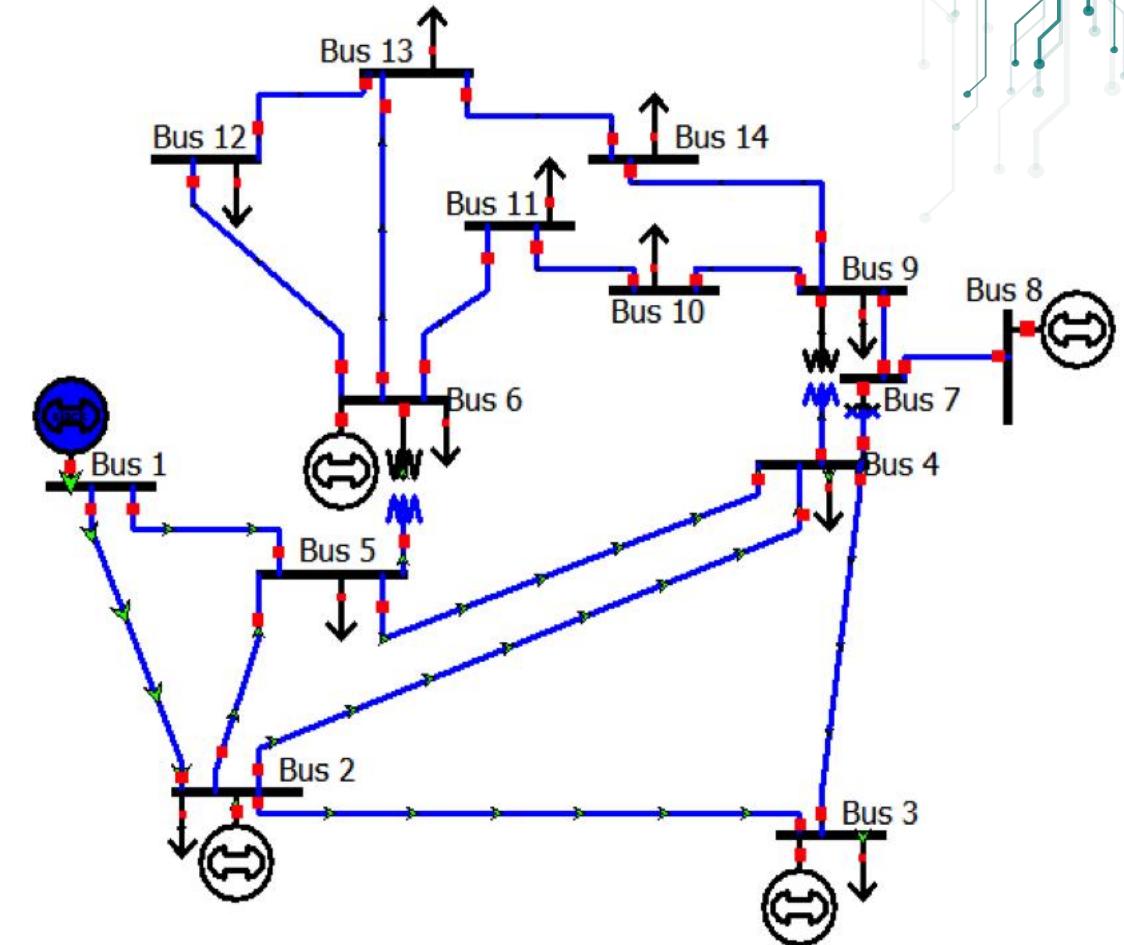
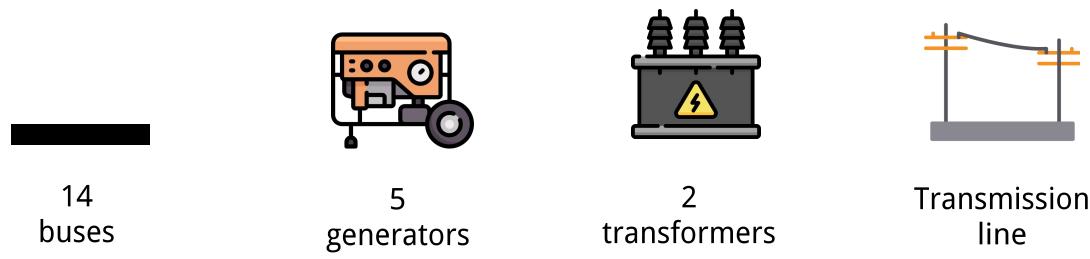


Simulink Model of The Study Area

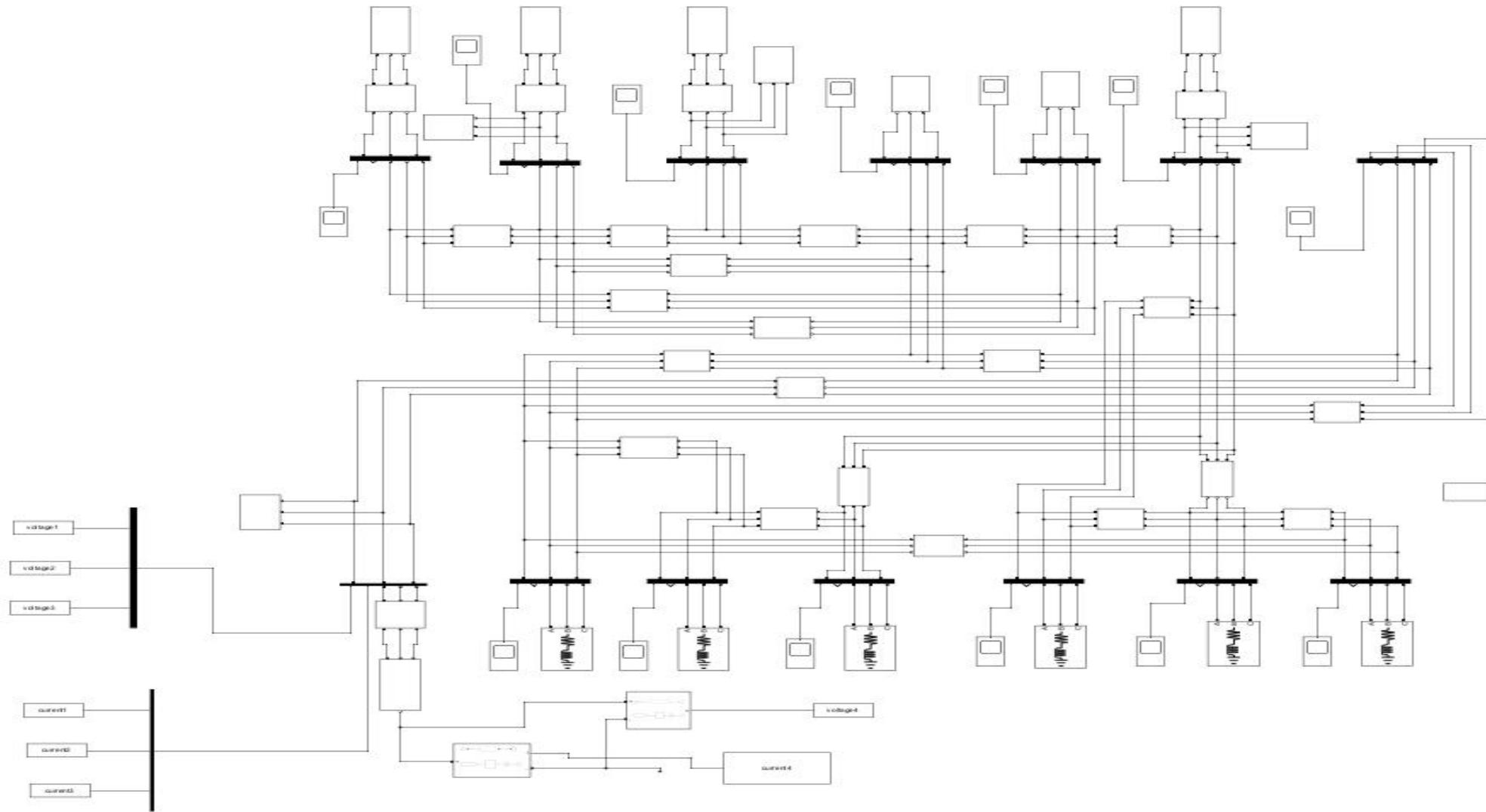


IEEE 14 Bus

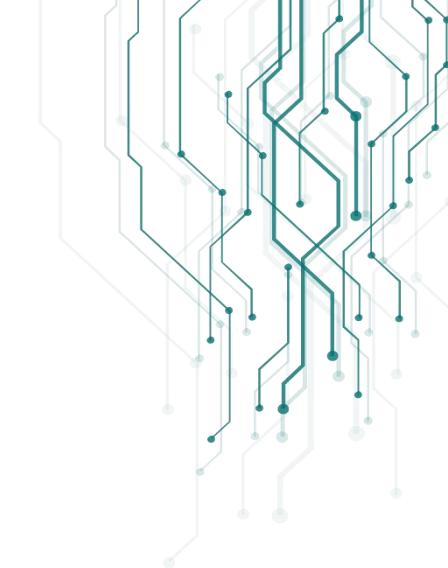
MATLAB Simulink model development with



14 Bus Simulink Model

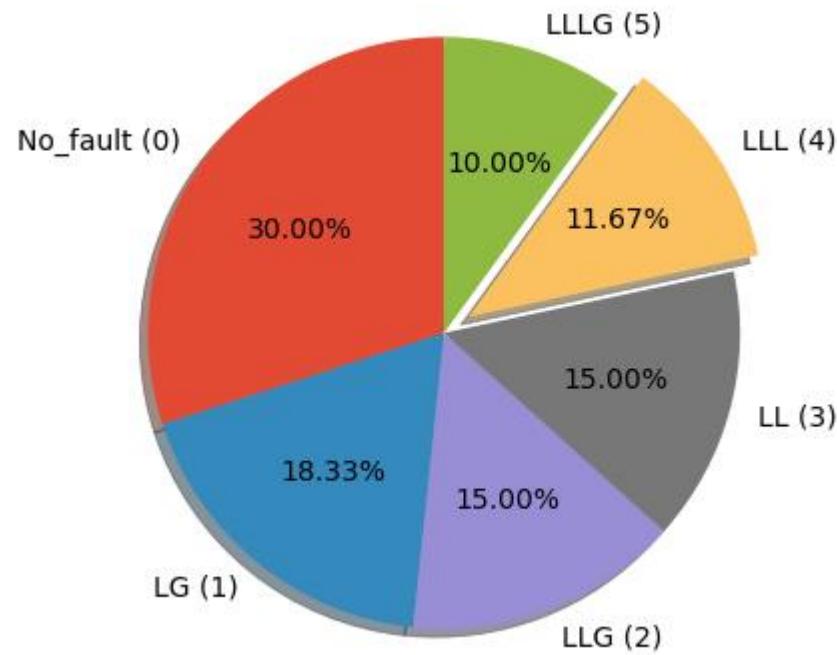


Data and Fault Classification Method



Total Data Generated : 76

Each Sample : 6 time series data with 100 samples



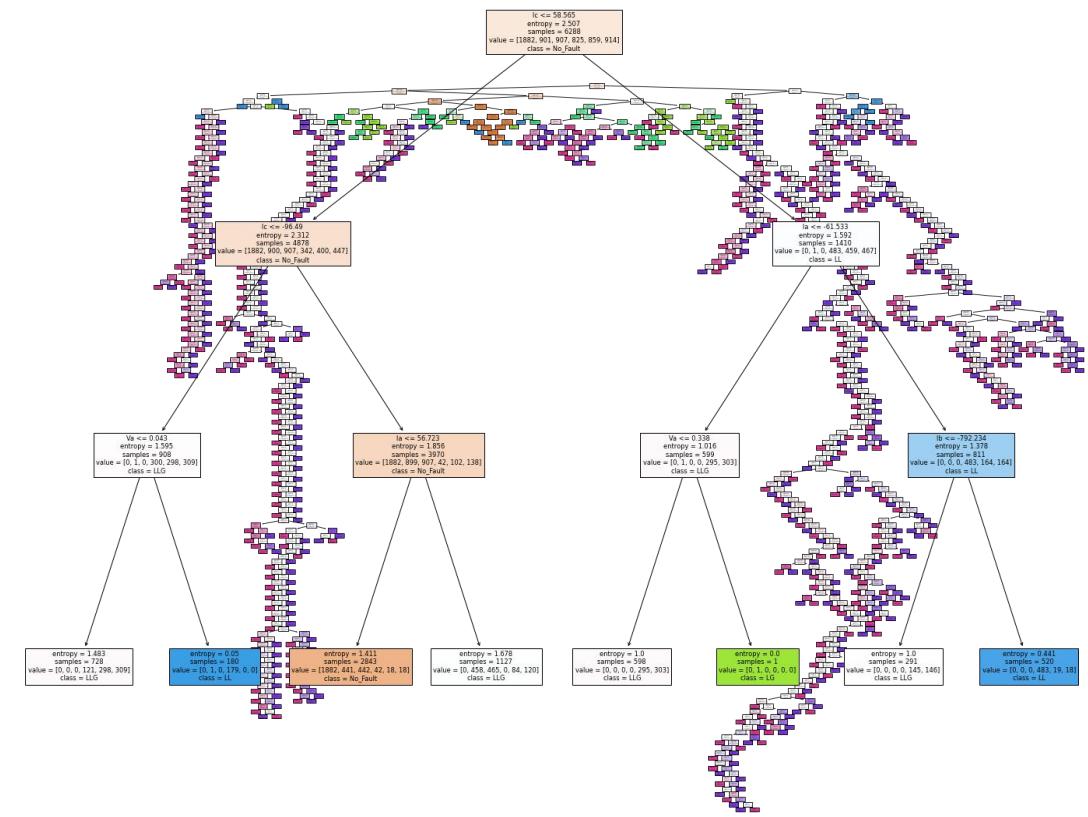
Time Series Data

la	lb	lc	Va	Vb	Vc	Fault_type
-151.291812	-9.677452	85.800162	0.400750	-0.132935	-0.267815	1
-336.186183	-76.283262	18.328897	0.312732	-0.123633	-0.189099	1
-502.891583	-174.648023	-80.924663	0.265728	-0.114301	-0.151428	1
-593.941905	-217.703359	-124.891924	0.235511	-0.104940	-0.130570	1
-643.663617	-224.159427	-132.282815	0.209537	-0.095554	-0.113983	1

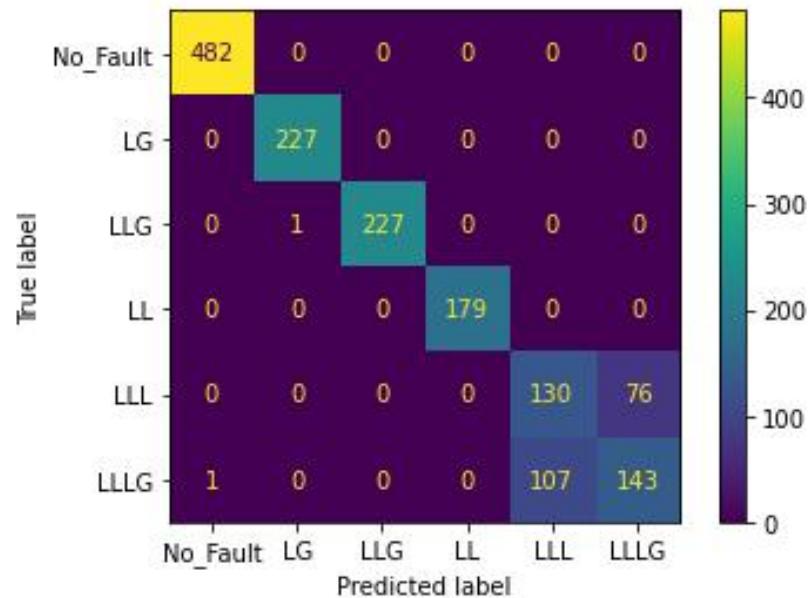
Machine Learning Method



Decision tree Classifier



Results & Conclusion

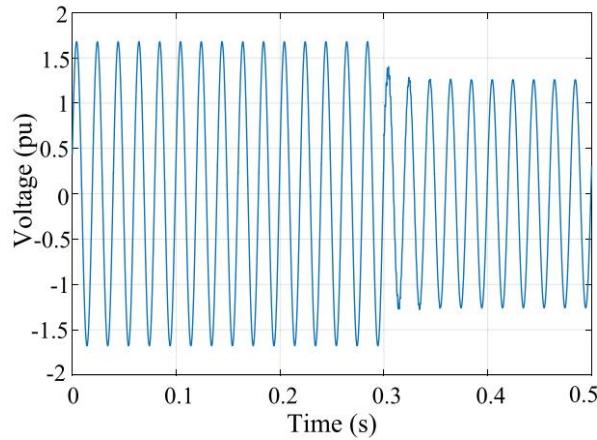


Accuracy of the Training dataset is : 100.0 %
Accuracy of the validation dataset is :
88.239033%

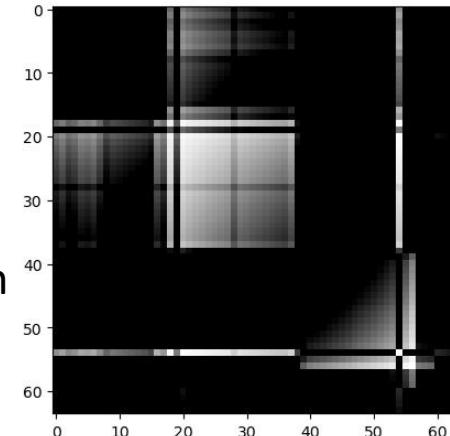
Deep Learning Method



Feature Extraction



GAF
Transformation

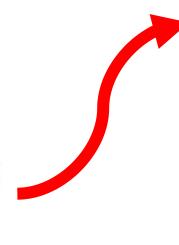


**Gramian Angular Field (GAF)
Transformation**

$$X = \{x_1, x_2, \dots, x_n\}$$

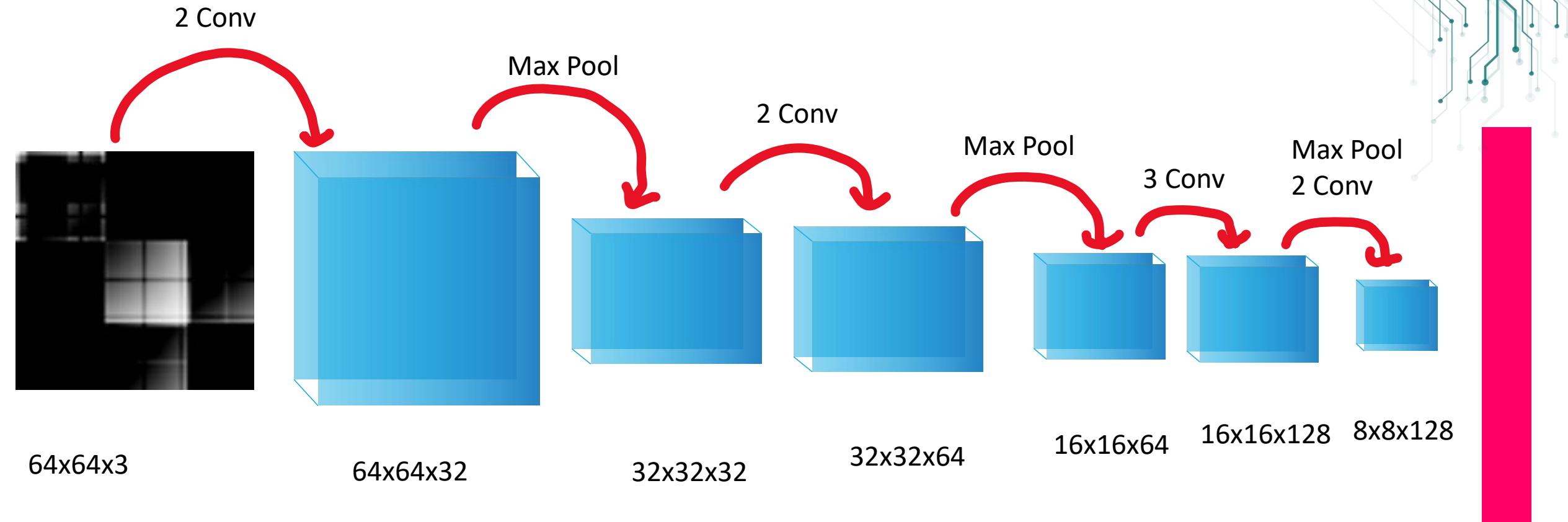


$$\begin{pmatrix} \langle \tilde{x}_1, \tilde{x}_1 \rangle & \dots & \langle \tilde{x}_1, \tilde{x}_n \rangle \\ \langle \tilde{x}_2, \tilde{x}_1 \rangle & \dots & \langle \tilde{x}_2, \tilde{x}_n \rangle \\ \vdots & \ddots & \vdots \\ \langle \tilde{x}_n, \tilde{x}_1 \rangle & \dots & \langle \tilde{x}_n, \tilde{x}_n \rangle \end{pmatrix}$$

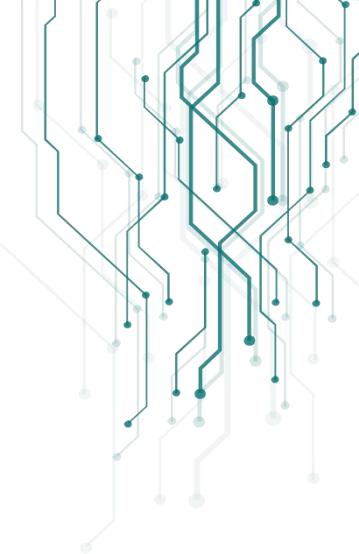
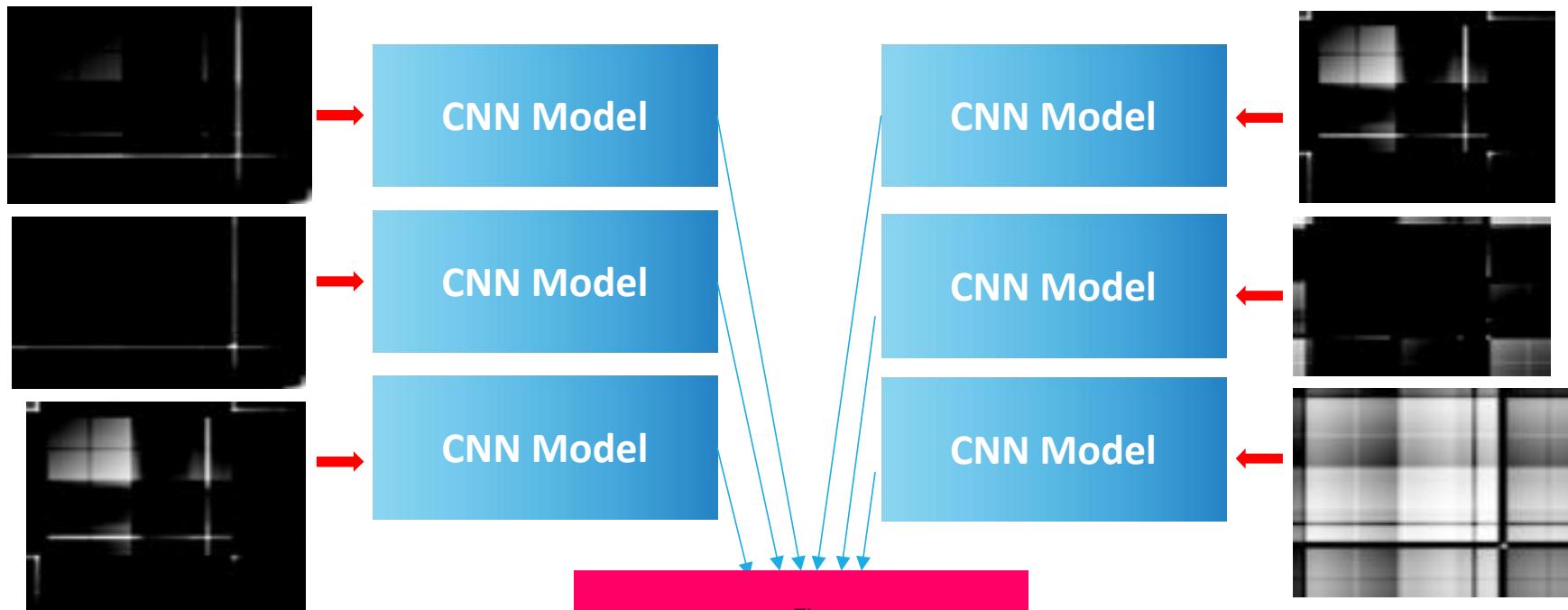


$$\langle x, y \rangle = x \cdot y - \sqrt{1 - x^2} \cdot \sqrt{1 - y^2}$$

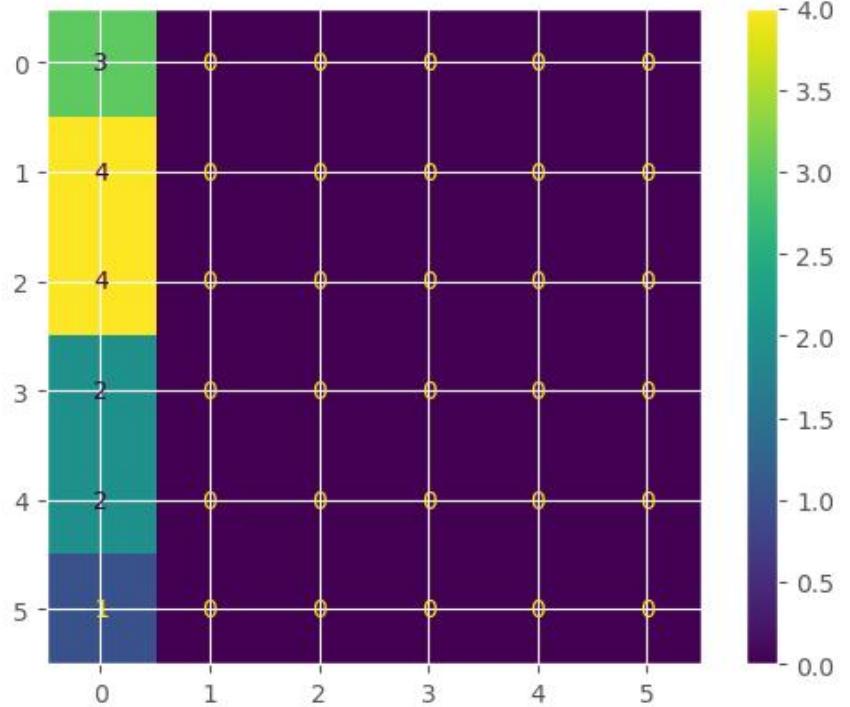
CNN Architecture



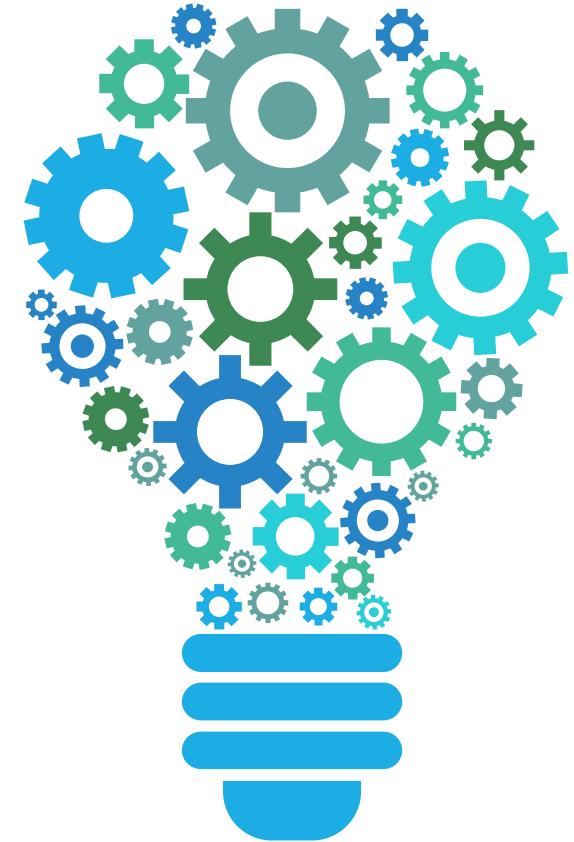
Model Architecture



Results & Conclusion

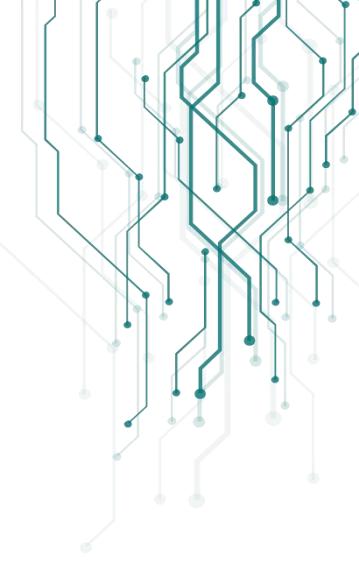


Validation loss is 2.087895393371582
Accuracy of the validation data is
18.75%



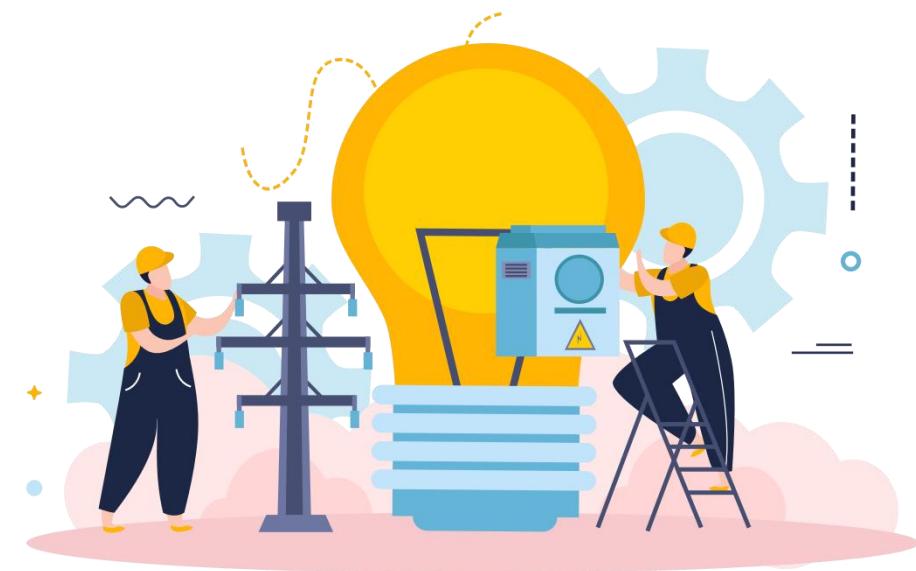
Future Prospect

- Computational Power
- Research Paper
- Benefit PGCB for Faster Fault Classification



References

- **Mother Paper :** <https://www.sciencedirect.com/science/article/pii/S037877962030242X>
- **Initial Resource :** <https://www.kaggle.com/datasets/esathyaprakash/electrical-fault-detection-and-classification>



THANK YOU