Prediction of processing defect of CNC machine

Advance quality control project proposal

Objective

Previously, manufacturers could not detect the defection of products before the whole production process is over.

⇒ We intended to **predict** processing defect of computerized numerical control(CNC) machine* using various machine data.

⇒ Early detection of defect, save time and costs.

*CNC machine : automated control of machining tools by means of a computer
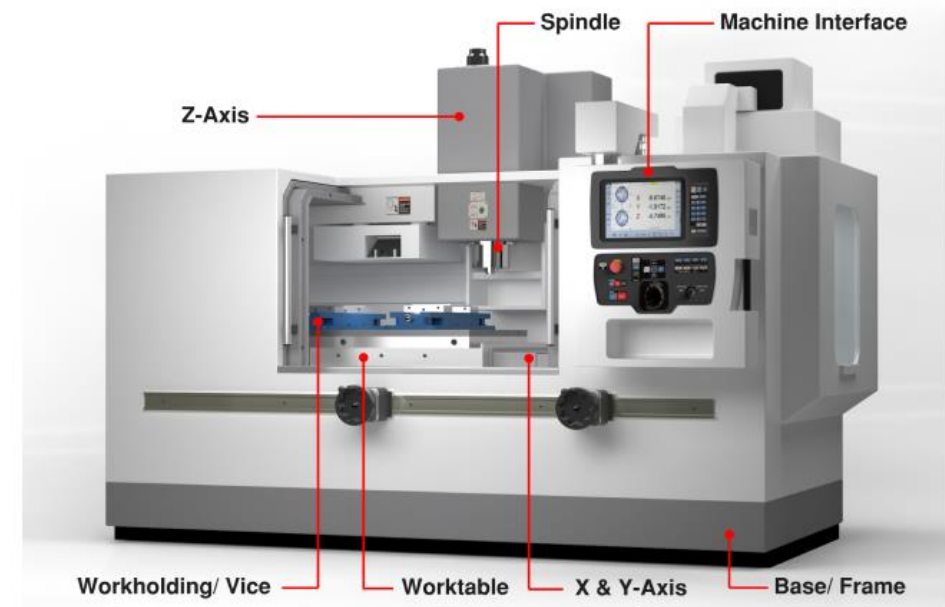
[CNC machine]

Dataset description & Baseline method

[Dataset]

▪ Processing production data of CNC machine from automotive parts production.

▪ Contains 48 attributes and 2 (binary) labels that indicate the quality of the products.

▪ label distribution(pass/fail) : 0.7/0.3 (22654/9403)

⇒I chose this dataset because it has abundant attributes compared to other datasets provided.

[Baseline method]

• Conduct binary classification by training a fully connected layer(FCN) after preprocessing the raw data.

Baseline method detail

[Preprocessing]
(1) Convert cvc files to dataframes
(2) Convert attribute value that has string type to integer values
(3) Use a partial number of samples among positive labels to alleviate the class imbalance
(4) Scale the attribute values into the 0-1 range: to avoid bias when using attribute values that are measured at different scales.

[FCN model]

Architecture

Input : 48x128 (activation : relu, dropout* : 0.3) *to prevent overfitting

Hidden : 128x256, 256x512, 512x512, 512x256, 256x128 (activation : relu, dropout : 0.3)

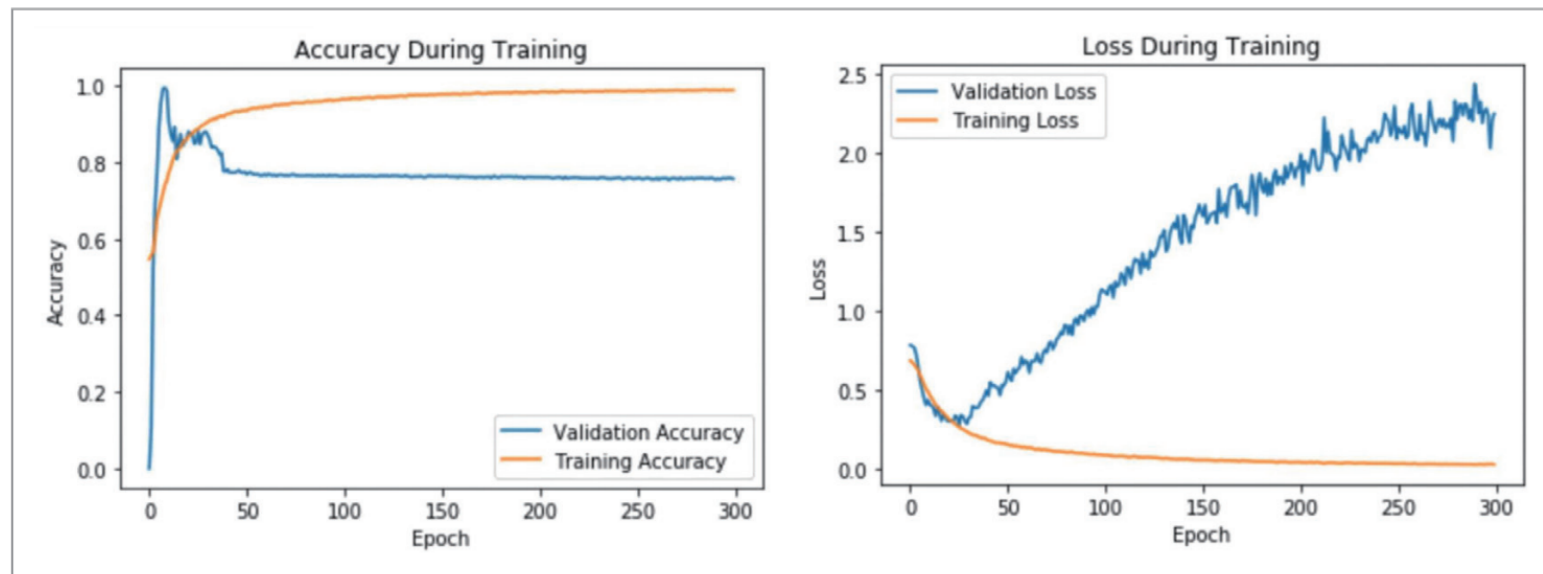Output : 128x2 (activation : sigmoid)

Baseline method detail & Results

[FCN model]

Optimizer : Adam, Batch size : 1024, Epoch : 300, lr : 1e-4

[Results]

[Accuracy and loss plot]

[Accuracy]

	Accuracy
Training	97.18
Validation	99.60
Test	91.51

Result analysis & discussion

- Model converges quite early

⇒Utilizing an **early stopping** mechanism will prevent overfitting

- There's room for improvements

⇒**Test accuracy is considerably low** compared to training accuracy given that this is a simple binary classification problem

⇒**To improve the model's generalizability: various metric learning methods like margin loss and contrastive learning can help**

- Needs extensive experiments in architecture design