**Table of Contents**

[Flowchart](#_6kunzyr12n18) **1**

[1.1 Data Collection](#_7bieiyey0fij) **1**

[1.2 Preprocessing Data](#_csjwzmcf2foa) **1**

[1.3 Building Model](#_eos1fxvs28hq) **2**

[Table 1 : Detailed parameters of new proposed 1D-CNN model](#_zdpomlaf6cro) 2

[1.4 Training](#_j351q1qtun0a) **2**

[1.5 Testing](#_pd0wptxeiq2f) **2**

## Flowchart



## 1.1 Data Collection

There were 2 classes in the data named as confused and not confused. The confused class was labeled as 0 and not confused was labeled 1.

Number of samples in confused class : 46

Number of samples in not confused class : 44

## 1.2 Preprocessing Data

Due to less number of samples in the data we have earlier applied a resample technique but in that method the data gets duplicated due to which issue of overfitting may arise.

In order to solve this issue we generated random noise with a particular mean and standard deviation same as that of size of the original data. The randomly generated noise was added to the original data in order to generate more samples.

But only 10%, 20% and 30% noise was added in order to generate more data keeping in mind that original data and generated data have less variation in mean and standard deviation.

After adding noise,the data generated has 184 samples in the confused class and 176 samples in the not confused class including the original samples.

## 1.3 Building Model

Number of layers, number of filters and kernel size in the earlier model was changed in order to obtain a model which performed better on new data.

### Table 1 : Detailed parameters of new proposed 1D-CNN model

| **Type of Layer** | **Output Shape** | **Other parameters** |
| --- | --- | --- |
| Conv1D  Batch Normalization  Max Pooling 1D | (None,105,64)  (None,105,64)  (None,52,64) | Filters = 64  Kernel size = 8  Pool size = 2  Activation = Relu |
| Conv1D  Batch Normalization  Max Pooling 1D | (None,45,32)  (None,45,32)  (None,22,32) | Filters = 32  Kernel size = 8  Pool size = 2  Activation = Relu |
| Conv1D  Batch Normalization  Max Pooling 1D | (None,15,16)  (None,15,16)  (None,7,16) | Filters = 16  Kernel size = 8  Pool size = 2  Activation = Relu |
| Flatten Layer | (None,112) |  |
| Dense Layer | (None,25) | Units = 25  Activation = Relu |
| Output Layer | (None,2) | Units = 2  Activation = Softmax |

Final output is of two classes.

## 1.4 Training

There were 287 samples giving to the model for training.Out of these samples 20% samples

were used for validation.

Training accuracy = 99.53%

Average Validation accuracy = 93.08% (mean of 83.5,93.06,98.61,95.83,94.4)

## 1.5 Testing

There were 73 samples given to the model for testing.

Each time different random noise is generated due to which accuracy may vary every time the model is run. So an average of 5 accuracies is taken as training accuracy.

The average testing accuracy was 97.02% (mean of 93.5,98.6,98.63,97.2,97.2)

The standard deviation of testing accuracy was 1.87