**Progress Report Draft | 23 February 2024**

1. **Neural Network Architecture**
   1. **3D CNN Model (ReLU)**

The architecture of the 3D CNN model follows the same architecture as the 2D CNN model with 2D layers being changed to 3D layers.

* **3D Convolutional Layers for Feature Extraction:**

Layer 1 consisting of 128 convolution filters with a kernel size of 3 x 3 x 3.

Layer 2 consisting of 128 convolution filters with a kernel size of 3 x 3 x 3.

Layer 3 consisting of 64 convolution filters with a kernel size of 3 x 3 x 3.

* **Max-Pooling Layers:**

3D max-pooling layers are used after each convolutional layer to reduce spatial dimensions.

* **Fully Connected Layers for Fall Detection**

Layer 1 consisting of 64 ReLU units.

Layer 2 consisting of 128 ReLU units.

Layer 3 consisting of 254 ReLU units.

* **Output Layer:**

2D SoftMax layer with a single binary output:

* Fall (represented as 1)
* No fall (represented as 0)
  1. **3D CNN Model (Gaussian Error Linear Unit - GeLU)**

The architecture of this model follows the same architecture as the previous 3D CNN model with the ReLU units swapped for GeLU.

* **3D Convolutional Layers for Feature Extraction:**

Layer 1 consisting of 128 convolution filters with a kernel size of 3 x 3 x 3.

Layer 2 consisting of 128 convolution filters with a kernel size of 3 x 3 x 3.

Layer 3 consisting of 64 convolution filters with a kernel size of 3 x 3 x 3.

* **Max-Pooling Layers:**

3D max-pooling layers are used after each convolutional layer to reduce spatial dimensions.

* **Fully Connected Layers for Fall Detection**

Layer 1 consisting of 64 GeLU units.

Layer 2 consisting of 128 GeLU units.

Layer 3 consisting of 254 GeLU units.

* **Output Layer:**

2D SoftMax layer with a single binary output:

* Fall (represented as 1)
* No fall (represented as 0)

1. **Results**
   1. **Metrics**

The metrics used to evaluate the model were Accuracy, Precision, Recall, Specificity, and F1-Score as shown in the descriptions below.

* **Accuracy**

The ratio of correctly predicted instances to the total instances

* **Precision**

The ratio of correctly predicted positives observations to the total predicted positives

* **Recall (Sensitivity)**

The ratio of correctly predicted positives observations to all the actual positives

* **Specificity**

The ratio of correctly predicted negative observations to all the actual negatives.

* **F1-Score**

The weighted average of Precision and Recall

1. **Evaluation** 
   1. **Comparative Analysis**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Data** | **Accuracy** | **Precision** | **Recall** | **Specificity** | **F1-Score** | **Loss** |
| **Research** | **95.64** | **96.91** | **97.95** | **83.08** | **97.43** |  |
| **Replication** | **98.98** | **84.14** | **81.94** | **99.51** | **83.02** |  |
| **3D CNN BGS Canny**  **LR (0.0001)**  **Ep (50)** | **94.50** | **35.64** | **98.85** | **94.37** | **52.39** | **57.72** |
| **BGS findcon()**  **LR (0.0001)**  **Ep (50)** | 93.63 | 32.33 | 99.01 | 93.46 | 48.75 | 73.02 |
| **BGS findcon()**  **LR (0.0001)**  **Ep (100)** | 93.96 | 33.46 | 98.59 | 93.81 | 49.96 | 35.76 |
| **BGS findcon()**  **LR (0.00001)**  **Ep (50)** | 94.36 | 34.97 | 98.28 | 94.23 | 51.59 | 35.04 |
| **BGS findcon() LR (0.0001)**  **Ep (50) GeLU** | 93.62 | 32.28 | 98.85 | 93.45 | 48.66 | 69.69 |

Test Loss: 0.7302, Test Accuracy: 0.9363, Test Precision: 0.3233, Test Recall: 0.9901, Test Specificity: 0.9346, Test F1-Score: 0.4875 // Time taken: 745.568273599 seconds [12.42 min]

Test Loss: 0.3576, Test Accuracy: 0.9396, Test Precision: 0.3346, Test Recall: 0.9859, Test Specificity: 0.9381, Test F1-Score: 0.4996 // Time taken: 1333.7722436999975 seconds [ 22.22 min]

Test Loss: 0.3504, Test Accuracy: 0.9436, Test Precision: 0.3497, Test Recall: 0.9828, Test Specificity: 0.9423, Test F1-Score: 0.5159 // Time taken: 741.4168626000028 seconds [12.35 min]

Test Loss: 0.6969, Test Accuracy: 0.9362, Test Precision: 0.3228, Test Recall: 0.9885, Test Specificity: 0.9345, Test F1-Score: 0.4866 // Total Time taken: 743.8618334999992 seconds [12.39 min]

* 1. **Graphs**

A blue and white graph

Description automatically generated

Figure Confusion Matrix - BGS findcon() LR[0.0001] E[50]

A group of graphs on a white background

Description automatically generated

Figure Results - BGS findcon() LR[0.0001] E[50]

A blue and white graph

Description automatically generated

Figure Confusion Matrix - BGS findcon() LR[0.0001] E[100]

A graph of a graph

Description automatically generated with medium confidence

Figure Results - BGS findcon() LR[0.0001] E[100]

A blue and white graph

Description automatically generated

Figure Confusion Matrix - BGS findcon() LR[0.00001] E[50]

A graph of a graph

Description automatically generated with medium confidence

Figure Results - BGS findcon() LR[0.00001] E[50]

A blue and white graph

Description automatically generated

Figure Confusion Matrix - BGS findcon() LR[0.0001] E[50] GeLU

A graph of a graph

Description automatically generated with medium confidence

Figure Results - BGS findcon() LR[0.0001] E[50] GeLU