Detection of Cardio Vascular Diseases of MIT_BIH Dataset using CNN

In [3]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from keras.models import Sequential
from keras.layers import Conv1D, MaxPooling1D, Flatten, Dense, Dropout
from keras.utils import to_categorical
```

In [4]:

```
!pip install wfdb
```

```
Collecting wfdb
  Downloading wfdb-4.1.2-py3-none-any.whl (159 kB)
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Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from
python-dateutil>=2.7->matplotlib>=3.2.2->wfdb) (1.16.0)
Installing collected packages: wfdb
Successfully installed wfdb-4.1.2
```

In [5]:

```
import wfdb
from wfdb import processing


wfdb.dl_database('mitdb', dl_dir='mitdb')


record = wfdb.rdrecord('mitdb/100', sampfrom=0, sampto=10000)
annotation = wfdb.rdann('mitdb/100', 'atr', sampfrom=0, sampto=10000)
```

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Created local base download directory: mitdb
Downloading files...
Finished downloading files
```

In [6]:

```
signal = record.p_signal[:, 0]
ann_samples = annotation.sample

window_size = 180  # Number of samples per segment
X = []
y = []
for ann in ann_samples:
    start = ann - window_size // 2
    end = ann + window_size // 2
    if start >= 0 and end < len(signal):
        X.append(signal[start:end])
        y.append(annotation.symbol[np.where(annotation.sample == ann)[0][0]])

# Convert lists to numpy arrays
X = np.array(X)
y = np.array(y)

# Filter out non-beat annotations (e.g., labels like 'N', 'L', 'R')
valid_labels = ['N', 'L', 'R']  # Adjust based on desired labels
X = X[np.isin(y, valid_labels)]
y = y[np.isin(y, valid_labels)]

# Convert labels to integers
label_mapping = {label: idx for idx, label in enumerate(valid_labels)}
y = np.array([label_mapping[label] for label in y])

# Normalize the data
scaler = StandardScaler()
X = scaler.fit_transform(X)
```

```
# One-hot encode the labels
y = to_categorical(y)
```

In [7]:

```
# Cell 5: Split the data into training and testing sets
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42
)
```

In [8]:

```
# Cell 6: Reshape data for the CNN
X_train = X_train.reshape(X_train.shape[0], X_train.shape[1], 1)
X_test = X_test.reshape(X_test.shape[0], X_test.shape[1], 1)
```

In [9]:

```
# Cell 7: Define the CNN model
model = Sequential([
    Conv1D(64, kernel_size=3, activation='relu', input_shape=(X_train.shape[1], 1)),
    MaxPooling1D(pool_size=2),
    Dropout(0.5),
    Conv1D(128, kernel_size=3, activation='relu'),
    MaxPooling1D(pool_size=2),
    Dropout(0.5),
    Flatten(),
    Dense(128, activation='relu'),
    Dropout(0.5),
    Dense(y_train.shape[1], activation='softmax')
])

# Compile model
model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
```

In [10]:

```
history = model.fit(X_train, y_train, validation_split=0.2, epochs=20, batch_size=32)
```

```
Epoch 1/20
```

```
/usr/local/lib/python3.10/dist-packages/tensorflow/python/util/dispatch.py:1260: SyntaxWa
rning: In loss categorical_crossentropy, expected y_pred.shape to be (batch_size, num_cla
sses) with num_classes > 1. Received: y_pred.shape=(None, 1). Consider using 'binary_cros
sentropy' if you only have 2 classes.
  return dispatch_target(*args, **kwargs)
```

```
1/1 [==============================] - 2s 2s/step - loss: 0.0000e+00 - accuracy: 1.0000 -
val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 2/20
1/1 [==============================] - 0s 109ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 3/20
1/1 [==============================] - 0s 103ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 4/20
1/1 [==============================] - 0s 106ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 5/20
1/1 [==============================] - 0s 63ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 6/20
1/1 [==============================] - 0s 75ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 7/20
1/1 [==============================] - 0s 76ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 8/20
1/1 [==============================] - 0s 71ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 9/20
```

```
1/1 [==============================] - 0s 61ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 10/20
1/1 [==============================] - 0s 77ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 11/20
1/1 [==============================] - 0s 73ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 12/20
1/1 [==============================] - 0s 155ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 13/20
1/1 [==============================] - 0s 102ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 14/20
1/1 [==============================] - 0s 114ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 15/20
1/1 [==============================] - 0s 96ms/step - loss: 0.0000e+00 - accuracy: 1.0000
- val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 16/20
1/1 [==============================] - 0s 121ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 17/20
1/1 [==============================] - 0s 136ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 18/20
1/1 [==============================] - 0s 108ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 19/20
1/1 [==============================] - 0s 135ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 20/20
1/1 [==============================] - 0s 124ms/step - loss: 0.0000e+00 - accuracy: 1.000
0 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
```

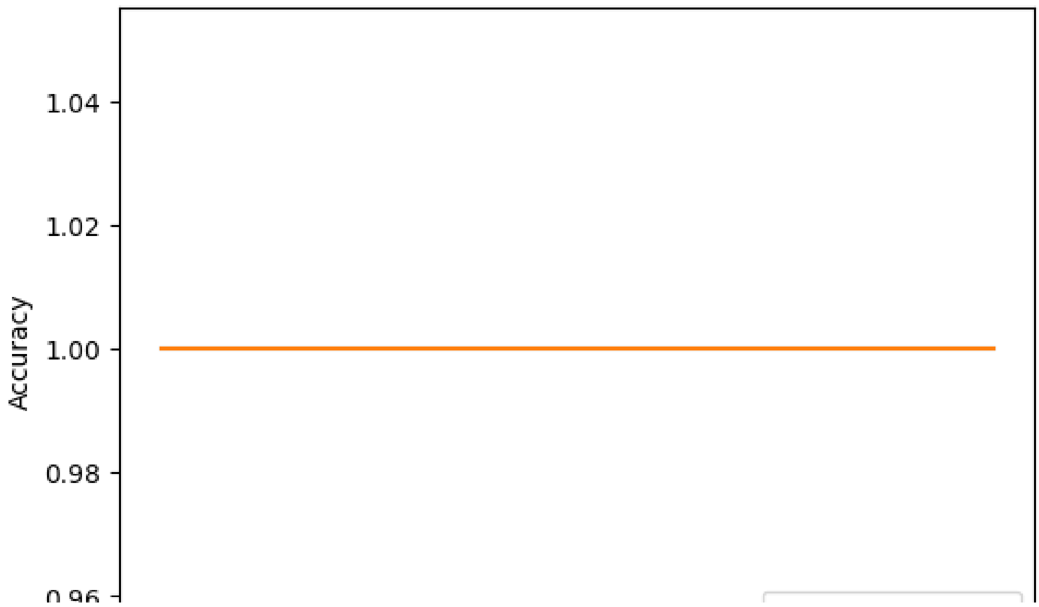
In [11]:

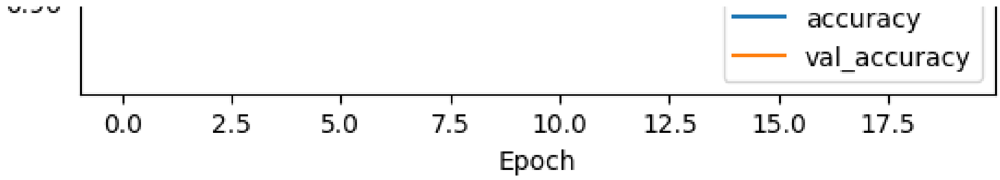
```
score = model.evaluate(X_test, y_test, verbose=0)
print(f'Test accuracy: {score[1]*100:.2f}%')
```

```
Test accuracy: 100.00%
```

In [12]:

```
plt.plot(history.history['accuracy'], label='accuracy')
plt.plot(history.history['val_accuracy'], label='val_accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend(loc='lower right')
plt.show()
```





In [14]:

```
# Cell 11: Import additional libraries for confusion matrix and metrics
from sklearn.metrics import confusion_matrix, classification_report
import seaborn as sns

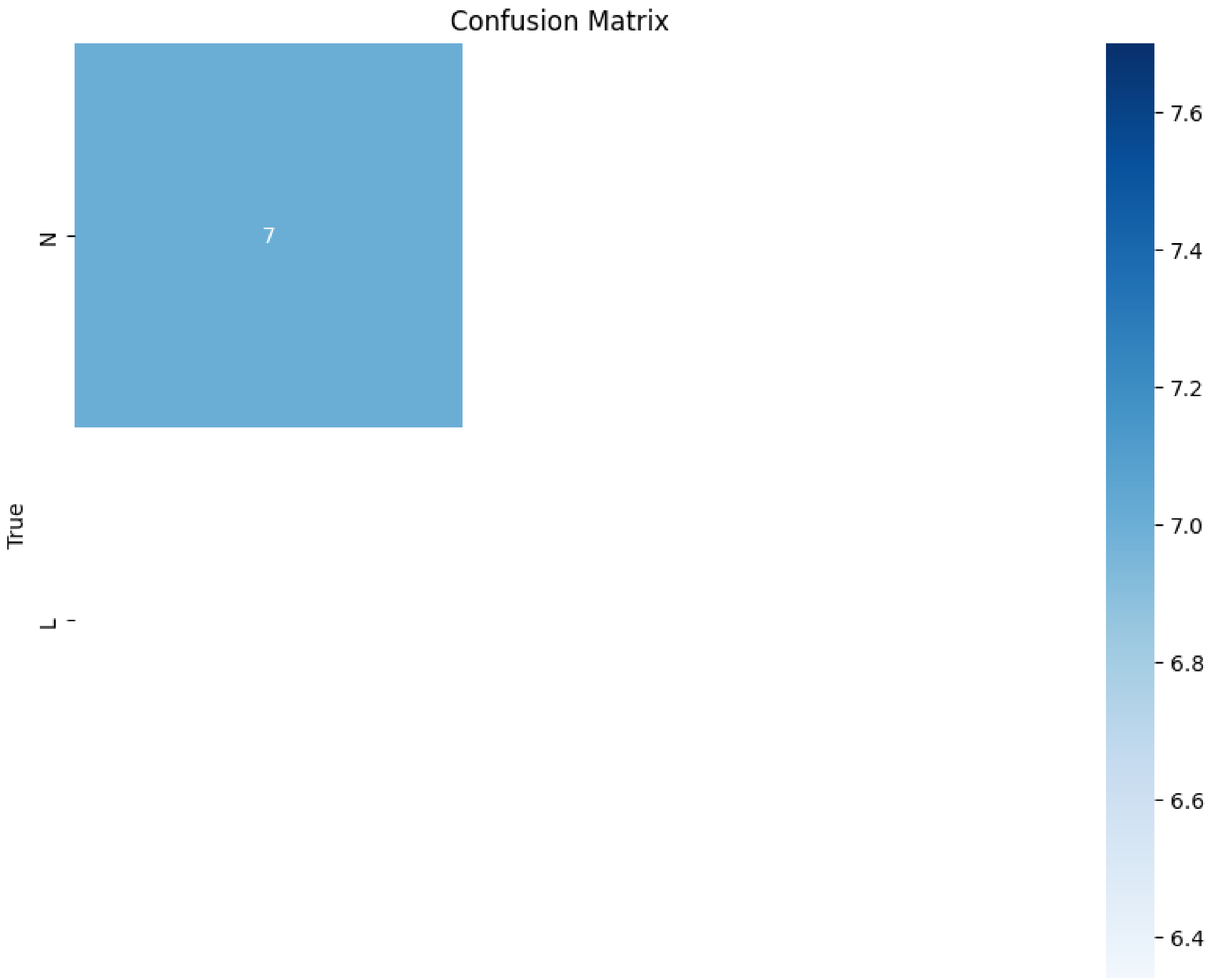
# Predict the labels for the test set
y_pred = model.predict(X_test)
y_pred_classes = np.argmax(y_pred, axis=1)
y_true = np.argmax(y_test, axis=1)

# Ensure the number of classes matches the valid_labels
unique_labels = np.unique(y_true)

# Compute confusion matrix
cm = confusion_matrix(y_true, y_pred_classes)

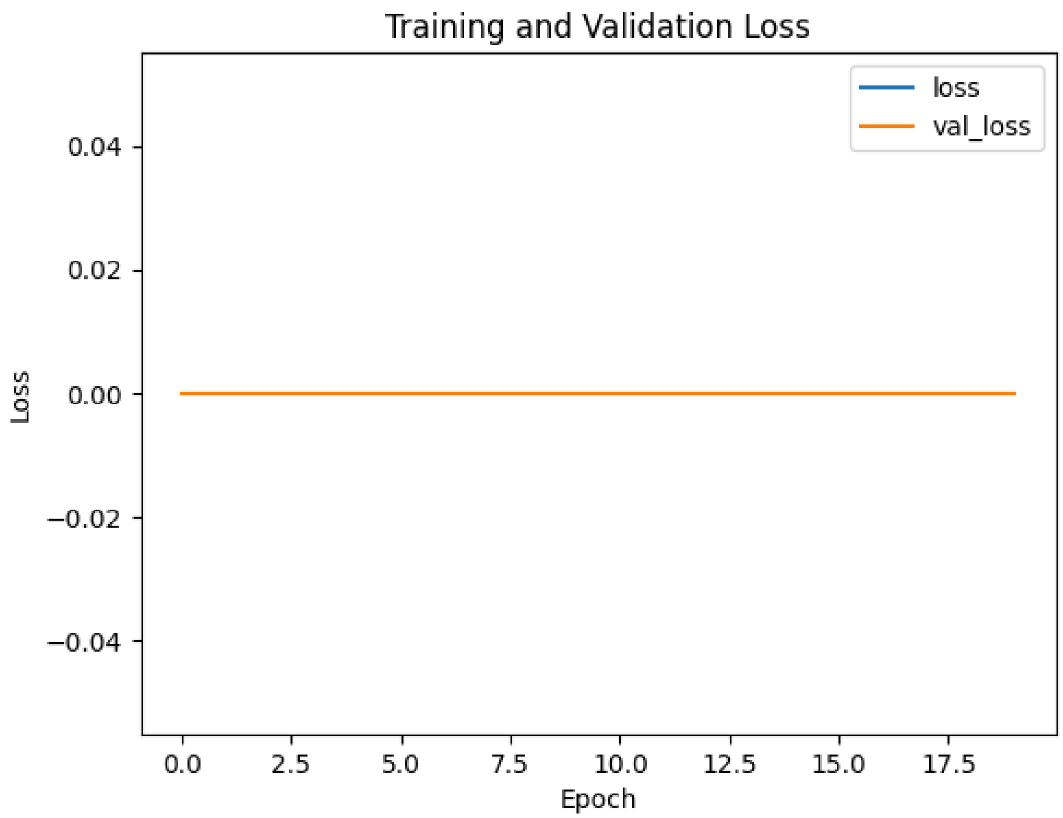
# Plot confusion matrix heatmap
plt.figure(figsize=(10, 8))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=valid_labels, yticklabels
=valid_labels)
plt.xlabel('Predicted')
plt.ylabel('True')
plt.title('Confusion Matrix')
plt.show()
```

```
1/1 [==============================] - 0s 23ms/step
```



In [ ]:

```python
# Cell 13: Plot training and validation loss
plt.plot(history.history['loss'], label='loss')
plt.plot(history.history['val_loss'], label='val_loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend(loc='upper right')
plt.title('Training and Validation Loss')
plt.show()
```

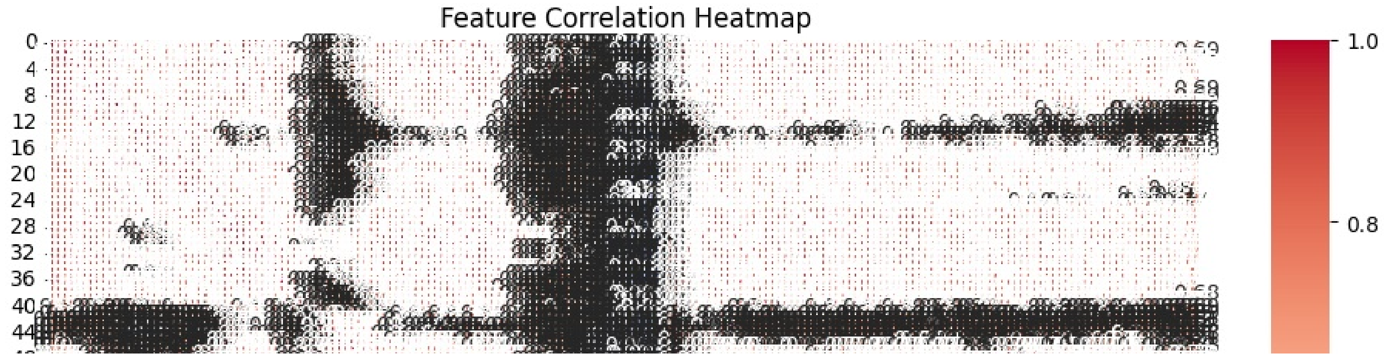


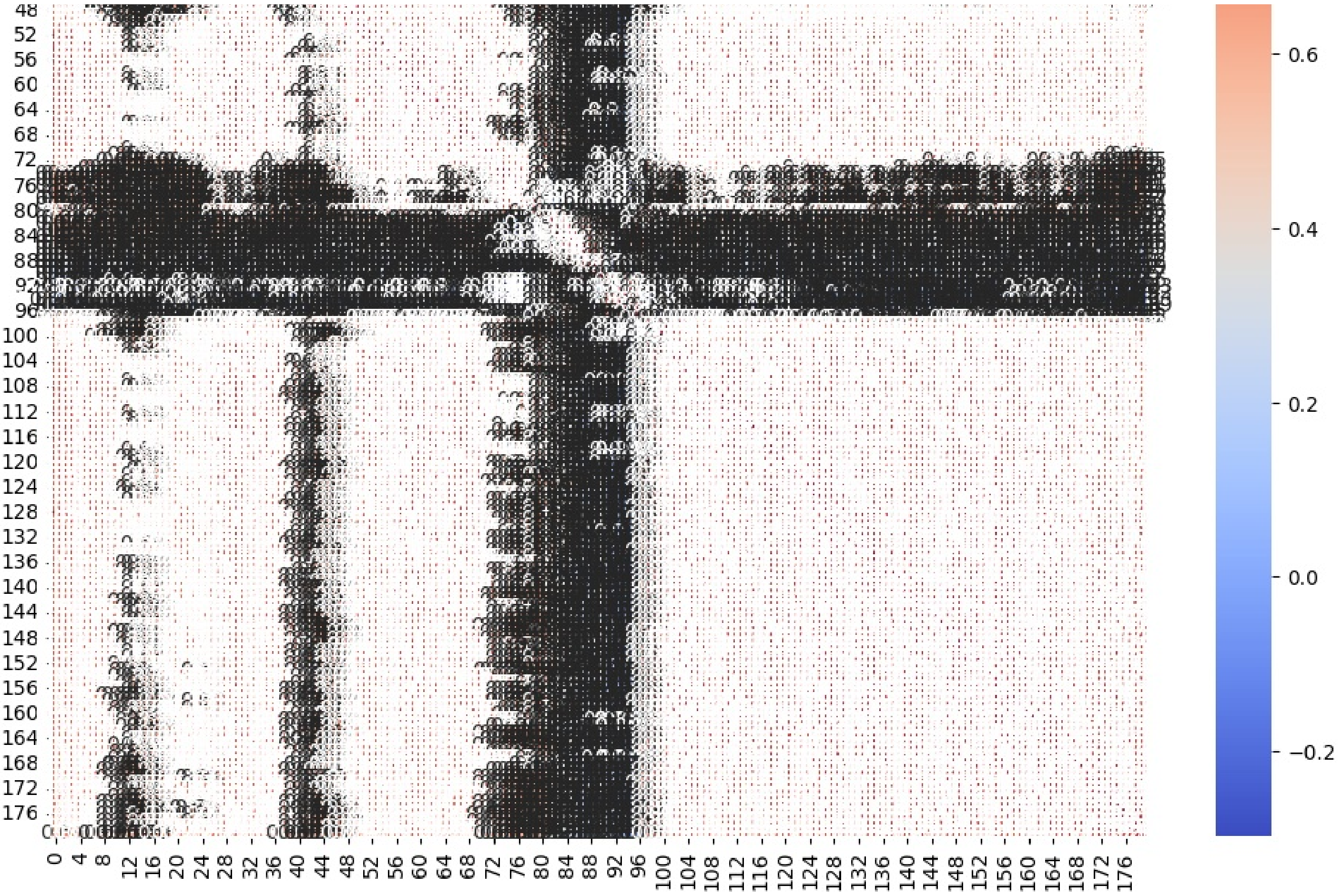
In [17]:

```python
# Cell 15: Heatmap of Feature Correlations (Optional)
# Note: This is more relevant if you have multiple features, e.g., using multiple channel
s or extracted features.

# Assuming `X` is the original feature set (before train/test split)
# Compute the correlation matrix
correlation_matrix = pd.DataFrame(X).corr()

# Plot heatmap
plt.figure(figsize=(12, 10))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title('Feature Correlation Heatmap')
plt.show()
```





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In [ ]: