In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense
```

```
Matplotlib is building the font cache; this may take a moment.
```

In [2]:
```
time_steps = np.linspace(0, 100, 500)
data = np.sin(time_steps) + np.random.normal(0, 0.1, 500)
scaler = MinMaxScaler(feature_range=(0, 1))
data_scaled = scaler.fit_transform(data.reshape(-1, 1))
```

In [3]:
```
def create_sequences(data, sequence_length):
    X, y = [], []
    for i in range(len(data) - sequence_length):
        X.append(data[i:i+sequence_length])
        y.append(data[i+sequence_length])
    return np.array(X), np.array(y)
```

In [4]:
```
sequence_length = 50
X, y = create_sequences(data_scaled, sequence_length)
X = X.reshape((X.shape[0], X.shape[1], 1))
```

In [5]:
```
model = Sequential([
    LSTM(50, return_sequences=False, input_shape=(sequence_length, 1)),
    Dense(1)
])

model.compile(optimizer='adam', loss='mse')
model.summary()
```

```
c:\Users\admin\22610097_Yash-Potdar\.venv\Lib\site-packages\keras\src\layers
\rnn\rnn.py:200: UserWarning: Do not pass an `input_shape`/`input_dim` argume
nt to a layer. When using Sequential models, prefer using an `Input(shape)` o
bject as the first layer in the model instead.
  super().__init__(**kwargs)
```

Model: "sequential"

Layer (type)	Output Shape	Param #
lstm (LSTM)	(None, 50)	10,400
dense (Dense)	(None, 1)	51

Total params: 10,451 (40.82 KB)

Trainable params: 10,451 (40.82 KB)

Non-trainable params: 0 (0.00 B)

In [6]:
```
history = model.fit(X, y, epochs=30, batch_size=16, validation_split=0.1)
```

```
Epoch 1/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 7s 23ms/step - loss: 0.1443 - val_loss: 0.0527
Epoch 2/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0500 - val_loss: 0.0228
Epoch 3/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0164 - val_loss: 0.0022
Epoch 4/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0028 - val_loss: 0.0017
Epoch 5/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0019
Epoch 6/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0026 - val_loss: 0.0016
Epoch 7/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0022 - val_loss: 0.0015
Epoch 8/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0021 - val_loss: 0.0017
Epoch 9/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0023 - val_loss: 0.0017
Epoch 10/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 9ms/step - loss: 0.0023 - val_loss: 0.0024
Epoch 11/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0016
Epoch 12/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0022 - val_loss: 0.0015
Epoch 13/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0020 - val_loss: 0.0017
Epoch 14/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0022 - val_loss: 0.0016
Epoch 15/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0021 - val_loss: 0.0015
Epoch 16/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0020 - val_loss: 0.0015
Epoch 17/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0022 - val_loss: 0.0016
Epoch 18/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0022 - val_loss: 0.0018
Epoch 19/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0026 - val_loss: 0.0021
Epoch 20/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0028 - val_loss: 0.0018
Epoch 21/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0025 - val_loss: 0.0016
Epoch 22/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0019 - val_loss: 0.0017
Epoch 23/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0021 - val_loss: 0.0021
Epoch 24/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0021
Epoch 25/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0023 - val_loss: 0.0016
Epoch 26/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0017
Epoch 27/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0018
Epoch 28/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0023 - val_loss: 0.0016
Epoch 29/30
```

```
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0020 - val_loss: 0.0018
Epoch 30/30
26/26 ━━━━━━━━━━━━━━━━━━━━ 0s 8ms/step - loss: 0.0024 - val_loss: 0.0016
```

In [7]:
```
last_sequence = data_scaled[-sequence_length:]
predictions = []

for _ in range(100):
    last_sequence_reshaped = last_sequence.reshape((1, sequence_length, 1))
    next_value = model.predict(last_sequence_reshaped)
    predictions.append(next_value[0, 0])
    last_sequence = np.append(last_sequence[1:], next_value, axis=0)

predictions_rescaled = scaler.inverse_transform(
    np.array(predictions).reshape(-1, 1))
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 250ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 21ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 14ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 25ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 25ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 25ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 27ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 16ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 15ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 18ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 22ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 25ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 23ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 26ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 25ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 17ms/step
```

In [8]:
```
plt.figure(figsize=(12, 6))
plt.plot(data, label='Original Data')
plt.plot(range(len(data), len(data) + len(predictions_rescaled)),
         predictions_rescaled, label='Forecast')
plt.legend()
plt.title("Time Series Forecasting with LSTM")
plt.show()
```