In [7]:
```python
# Import necessary libraries
from sklearn.cluster import KMeans
from sklearn.metrics import davies_bouldin_score
from sklearn.preprocessing import MinMaxScaler
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

# Load your dataset (replace 'Customers.csv' with the actual file name)
customer_features = pd.read_csv("Customers.csv")

# Display the first few rows of the dataset
print("Dataset Loaded:")
print(customer_features.head())

# Step 1: Check column names
print("\nColumn Names in the Dataset:")
print(customer_features.columns)

# Step 2: Add necessary numeric columns if they are missing
if 'TotalSpent' not in customer_features.columns or 'TransactionCount' not in custo
    print("\nAdding dummy columns 'TotalSpent' and 'TransactionCount' for testing."
    customer_features['TotalSpent'] = np.random.randint(100, 1000, size=len(custome
    customer_features['TransactionCount'] = np.random.randint(1, 20, size=len(custo

# Display the updated dataset
print("\nUpdated Dataset with Numeric Columns:")
print(customer_features.head())

# Step 3: Normalize the features
scaler = MinMaxScaler()
scaled_features = scaler.fit_transform(customer_features[['TotalSpent', 'Transactio
print("\nNormalized Features:")
print(scaled_features)

# Step 4: Apply KMeans clustering
kmeans = KMeans(n_clusters=3, random_state=42)
customer_features["Cluster"] = kmeans.fit_predict(scaled_features)

# Step 5: Calculate Davies-Bouldin Index
db_index = davies_bouldin_score(scaled_features, customer_features["Cluster"])
print("\nDavies-Bouldin Index:", db_index)

# Step 6: Visualize the clusters
plt.scatter(scaled_features[:, 0], scaled_features[:, 1], c=customer_features["Clus
plt.xlabel("Total Spent")
plt.ylabel("Transaction Count")
plt.title("Customer Clusters")
plt.show()

# Step 7: Check cluster assignments
print("\nCluster Assignments:")
print(customer_features[["CustomerID", "Cluster"]])
```

```
Dataset Loaded:
  CustomerID         CustomerName           Region  SignupDate
0      C0001     Lawrence Carroll  South America  2022-07-10
1      C0002       Elizabeth Lutz           Asia  2022-02-13
2      C0003       Michael Rivera  South America  2024-03-07
3      C0004  Kathleen Rodriguez  South America  2022-10-09
4      C0005          Laura Weber           Asia  2022-08-15

Column Names in the Dataset:
Index(['CustomerID', 'CustomerName', 'Region', 'SignupDate'], dtype='object')

Adding dummy columns 'TotalSpent' and 'TransactionCount' for testing.

Updated Dataset with Numeric Columns:
  CustomerID         CustomerName           Region  SignupDate  TotalSpent  \
0      C0001     Lawrence Carroll  South America  2022-07-10         528
1      C0002       Elizabeth Lutz           Asia  2022-02-13         929
2      C0003       Michael Rivera  South America  2024-03-07         172
3      C0004  Kathleen Rodriguez  South America  2022-10-09         392
4      C0005          Laura Weber           Asia  2022-08-15         691

   TransactionCount
0                 1
1                 4
2                16
3                17
4                17

Normalized Features:
[[0.47699214 0.        ]
 [0.92704826 0.16666667]
 [0.07744108 0.83333333]
 [0.32435466 0.88888889]
 [0.65993266 0.88888889]
 [0.20426487 0.44444444]
 [0.09539843 0.77777778]
 [0.14590348 0.44444444]
 [0.7687991  0.88888889]
 [0.61503928 0.05555556]
 [0.9708193  1.        ]
 [0.72615039 0.55555556]
 [0.43883277 0.5       ]
 [0.50056117 0.22222222]
 [0.5993266  0.55555556]
 [0.89225589 0.88888889]
 [0.94837262 0.61111111]
 [0.92031425 0.66666667]
 [0.13243547 0.05555556]
 [0.91133558 1.        ]
 [0.15151515 0.72222222]
 [0.5308642  0.05555556]
 [0.25589226 0.5       ]
 [0.25476992 0.88888889]
 [0.81257015 0.22222222]
 [0.43434343 0.94444444]
 [0.47699214 0.44444444]
```

```
[0.45230079 0.05555556]
[0.71492705 0.38888889]
[0.21099888 0.66666667]
[0.28619529 0.55555556]
[0.20538721 0.61111111]
[0.82267116 0.55555556]
[0.44219978 0.        ]
[0.00112233 0.27777778]
[0.05723906 0.94444444]
[0.15375982 0.94444444]
[0.49719416 0.33333333]
[0.95061728 0.11111111]
[0.39955107 0.83333333]
[0.18181818 0.22222222]
[0.7654321  0.27777778]
[0.        0.11111111]
[0.87766554 0.16666667]
[0.15937149 0.77777778]
[0.31762065 0.72222222]
[0.41077441 0.83333333]
[0.75645342 0.05555556]
[0.36139169 0.11111111]
[0.32098765 0.44444444]
[0.03928171 1.        ]
[0.1627385  0.77777778]
[0.73400673 0.27777778]
[0.58585859 0.        ]
[0.65544332 0.16666667]
[0.45566779 0.22222222]
[0.48597082 0.72222222]
[0.24691358 0.5        ]
[0.93602694 0.77777778]
[0.85634119 0.38888889]
[0.36924804 0.44444444]
[0.90909091 0.83333333]
[0.4624018  0.22222222]
[0.99775533 1.        ]
[0.52525253 0.66666667]
[0.81593715 0.16666667]
[0.87878788 0.72222222]
[0.54433221 0.72222222]
[0.23569024 0.94444444]
[0.09090909 0.83333333]
[0.92704826 1.        ]
[0.04040404 0.44444444]
[0.8305275  0.22222222]
[0.07295174 1.        ]
[0.31425365 0.94444444]
[0.60157127 0.83333333]
[0.83838384 0.5        ]
[0.79349046 0.05555556]
[0.16386083 0.94444444]
[0.50841751 0.5        ]
[0.13468013 0.        ]
[0.12008979 0.66666667]
[0.49719416 1.        ]
```

```
[0.16049383 0.66666667]
[0.15263749 0.16666667]
[0.996633    0.        ]
[0.24466891 0.61111111]
[0.38271605 0.38888889]
[0.21099888 0.27777778]
[0.41077441 0.16666667]
[0.19304153 0.61111111]
[0.39955107 0.83333333]
[0.60606061 0.        ]
[0.54208754 0.44444444]
[0.89225589 0.61111111]
[0.44219978 0.55555556]
[0.40179574 0.22222222]
[0.37261504 0.72222222]
[0.47474747 0.22222222]
[0.31088664 0.22222222]
[0.56565657 0.94444444]
[0.77665544 0.94444444]
[0.61167228 0.44444444]
[0.45791246 0.05555556]
[0.1043771  0.22222222]
[0.52076319 0.        ]
[0.13243547 1.        ]
[0.82379349 0.05555556]
[0.86756453 0.55555556]
[0.64421998 0.66666667]
[0.33670034 0.61111111]
[0.8956229  0.61111111]
[0.85297419 0.        ]
[0.90460157 0.77777778]
[0.09539843 0.05555556]
[0.63860831 0.61111111]
[0.24466891 0.        ]
[0.84960718 0.94444444]
[0.04826038 0.61111111]
[0.51402918 0.        ]
[0.01346801 0.44444444]
[0.88103255 0.88888889]
[0.47362514 0.44444444]
[0.42760943 0.61111111]
[0.90684624 0.11111111]
[0.72390572 0.16666667]
[0.2345679  0.38888889]
[0.42760943 0.5       ]
[0.664422   0.11111111]
[0.50617284 0.44444444]
[0.11560045 0.22222222]
[0.93714927 0.5       ]
[0.49270483 0.16666667]
[0.85858586 0.38888889]
[0.79124579 0.33333333]
[0.94500561 0.        ]
[0.39169473 0.88888889]
[0.30751964 0.        ]
[0.65993266 0.72222222]
```

```
[0.64758698 0.66666667]
[0.05948373 0.33333333]
[0.15375982 0.77777778]
[0.27384961 0.11111111]
[0.14253648 0.22222222]
[0.99102132 0.27777778]
[0.20314254 0.72222222]
[0.60718294 0.72222222]
[0.30639731 0.83333333]
[0.90460157 0.72222222]
[0.74074074 0.72222222]
[0.01346801 0.44444444]
[0.52749719 0.61111111]
[0.99775533 0.16666667]
[0.68350168 0.88888889]
[0.50280584 0.5       ]
[0.65881033 0.05555556]
[0.5634119  0.83333333]
[0.14141414 0.66666667]
[0.34904602 0.66666667]
[0.86195286 0.72222222]
[0.83950617 0.66666667]
[0.61279461 0.44444444]
[0.24017957 0.61111111]
[0.00561167 0.83333333]
[0.30639731 1.        ]
[0.87317621 0.22222222]
[0.08305275 0.55555556]
[0.30976431 0.33333333]
[0.79461279 0.83333333]
[0.62065095 0.11111111]
[0.89337823 0.27777778]
[0.50056117 0.        ]
[0.05050505 0.77777778]
[0.98092031 0.22222222]
[0.65095398 0.72222222]
[0.43771044 0.38888889]
[0.65095398 1.        ]
[0.02132435 0.88888889]
[0.85521886 0.77777778]
[0.49607183 0.94444444]
[0.90123457 0.61111111]
[0.12570146 0.16666667]
[0.69248036 0.77777778]
[0.27160494 0.83333333]
[0.87317621 0.77777778]
[0.72615039 0.83333333]
[0.13916947 0.55555556]
[0.10213244 0.22222222]
[0.88888889 0.66666667]
[1.         0.33333333]
[0.09988777 0.77777778]
[0.97306397 0.61111111]
[0.42199776 0.16666667]
[0.88776655 0.05555556]
[0.30864198 0.66666667]
```

```
 [0.85297419 0.61111111]
 [0.06621773 0.94444444]
 [0.95959596 0.27777778]
 [0.23007856 1.        ]
 [0.52076319 0.        ]]
```

Davies-Bouldin Index: 0.7870253396637373
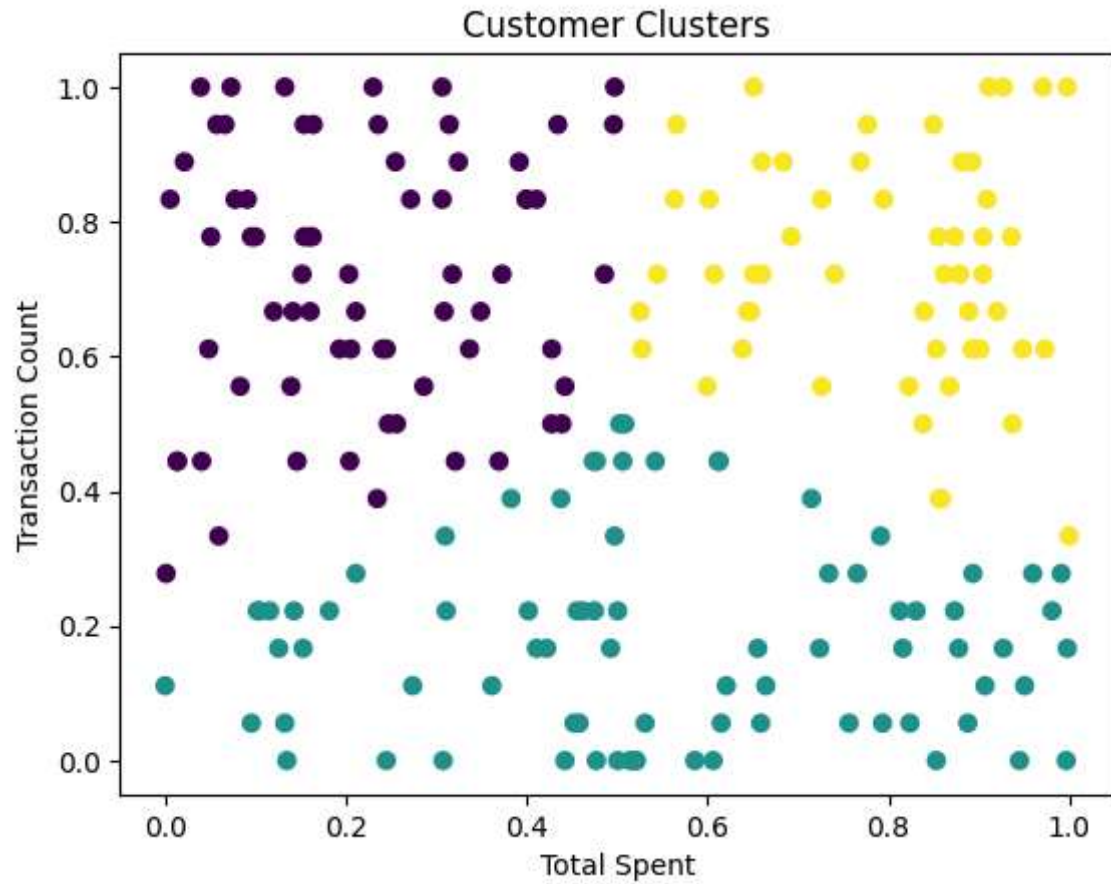
Customer Clusters

```
Cluster Assignments:
     CustomerID  Cluster
0        C0001        1
1        C0002        1
2        C0003        0
3        C0004        0
4        C0005        2
..         ...      ...
195      C0196        2
196      C0197        0
197      C0198        1
198      C0199        0
199      C0200        1

[200 rows x 2 columns]
```