PCA ANALYSIS ON MNIST DATASET

In [17]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
```

LOAD MINSNT DATASET

In [18]:
```
d0 = pd.read_csv('./mnist_train.csv')
```

In [19]:
```
print (d0.head(5))
```

```
   label  pixel0  pixel1  pixel2  pixel3  pixel4  pixel5  pixel6  pixel
7  \
0      1       0       0       0       0       0       0       0
0
1      0       0       0       0       0       0       0       0
0
2      1       0       0       0       0       0       0       0
0
3      4       0       0       0       0       0       0       0
0
4      0       0       0       0       0       0       0       0
0

   pixel8    ...     pixel774  pixel775  pixel776  pixel777  pixel778
\
0       0    ...            0         0         0         0         0

1       0    ...            0         0         0         0         0
```

```
2       0    ...            0          0          0          0          0

3       0    ...            0          0          0          0          0

4       0    ...            0          0          0          0          0


   pixel779  pixel780  pixel781  pixel782  pixel783
0         0         0         0         0         0
1         0         0         0         0         0
2         0         0         0         0         0
3         0         0         0         0         0
4         0         0         0         0         0

[5 rows x 785 columns]
```

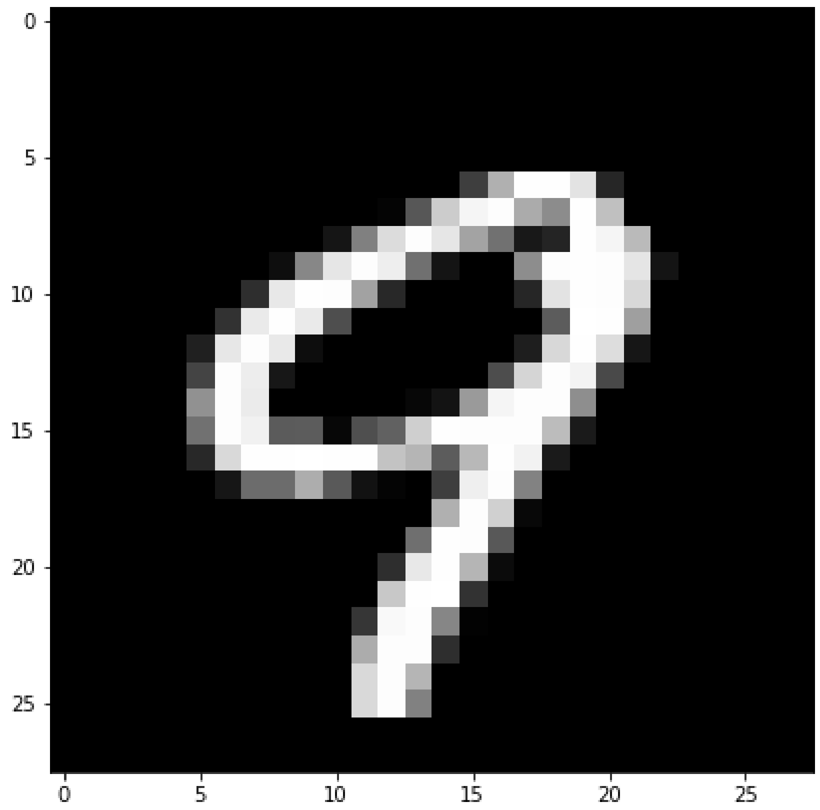
In [20]:
```
l = d0['label']
```

In [21]:
```
d = d0.drop ("label" , axis = 1)
```

In [22]:
```
print (d.shape)
print (l.shape)
```

```
(42000, 784)
(42000,)
```

In [23]:
```
#display plot number

plt.figure (figsize = (7,7))
idx = 100
grid_data = d.iloc[idx].as_matrix().reshape(28,28)
plt.imshow (grid_data , interpolation = "none" , cmap = "gray" )
plt.show()
print (l[idx])
```



```
9
```

2D VISUALIZATION USING PCA

In [24]:
```
labels = l.head(15000)
data = d.head(15000)

print ("The shape of sample data = " , data.shape)
```

```
The shape of sample data =  (15000, 784)
```

In [25]:
```
from sklearn.preprocessing import StandardScaler
```

In [26]:
```
standardized_data = StandardScaler().fit_transform(data)
print (standardized_data.shape)
```

```
(15000, 784)
```

In [27]:
```
#Find covariance matrix
sample_data = standardized_data

#matrix multipication using numpy
covar_matrix = np.matmul (sample_data.T , sample_data)
print ("The shape of variance matrix is = " , covar_matrix.shape)
```

```
The shape of variance matrix is =  (784, 784)
```

In [28]:
```
#finding top two eigen values and eigen vectors for projecting into 2 d
imension space

from scipy.linalg import eigh

values , vectors = eigh (covar_matrix , eigvals = (782, 783))

print ("Shape of eigen vectors" , vectors.shape)

vectors = vectors.T

print ("Updated shape of eigen vectors" , vectors.shape)
```

```
Shape of eigen vectors (784, 2)
Updated shape of eigen vectors (2, 784)
```

In [29]:
```
#projecting sample data on sample plane

import matplotlib.pyplot as plt

new_coordinates = np.matmul (vectors , sample_data.T)
```

```
print ("Resultant new data points " , vectors.shape  , "X" , sample_dat
a.T.shape," = ", new_coordinates.shape)
```

```
Resultant new data points  (2, 784) X (784, 15000)  =  (2, 15000)
```

In [30]:
```
import pandas as pd

new_coordinates = np.vstack ((new_coordinates, labels)).T
```

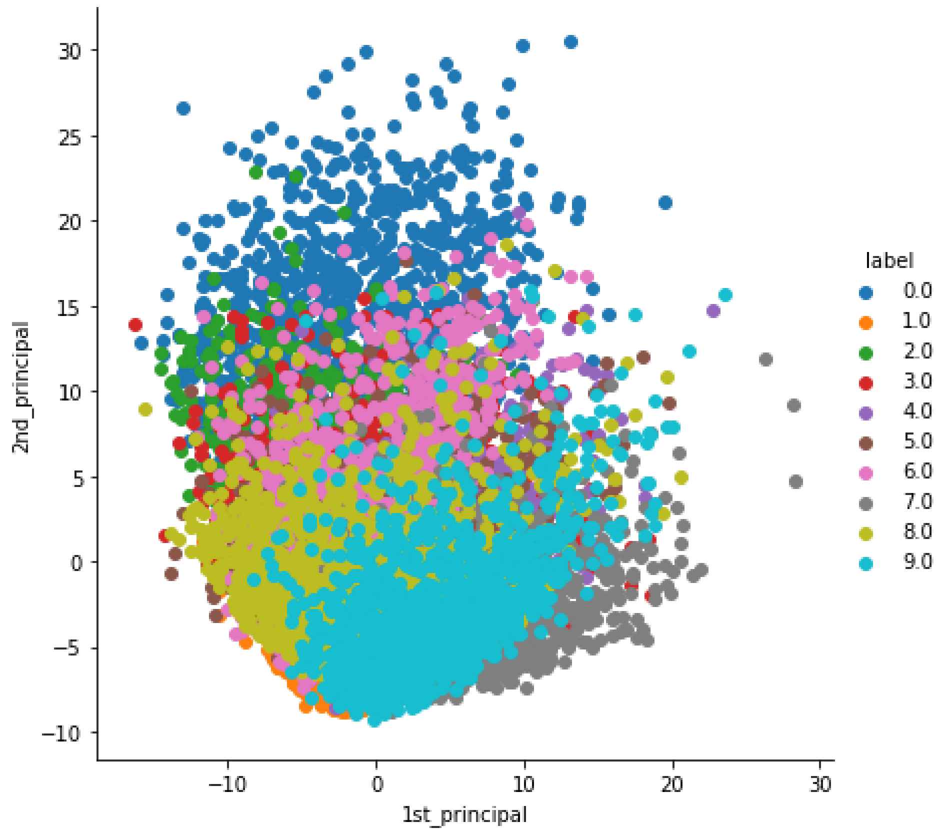
vstack is used to stack arrays vertically

In [35]:
```
# creating a new data frame for ploting the labeled points.
dataframe = pd.DataFrame(data=new_coordinates, columns=("1st_principal"
, "2nd_principal", "label"))
print(dataframe.head())
```

```
   1st_principal  2nd_principal  label
0      -5.558661      -5.043558    1.0
1       6.193635      19.305278    0.0
2      -1.909878      -7.678775    1.0
3       5.525748      -0.464845    4.0
4       6.366527      26.644289    0.0
```

PLOTTING 2D DataPoints with seaborn

In [36]:
```
import seaborn as sn
sn.FacetGrid(dataframe, hue="label", size=6).map(plt.scatter, '1st_prin
cipal', '2nd_principal').add_legend()
plt.show()
```



PCA using SCIKIT LEARN

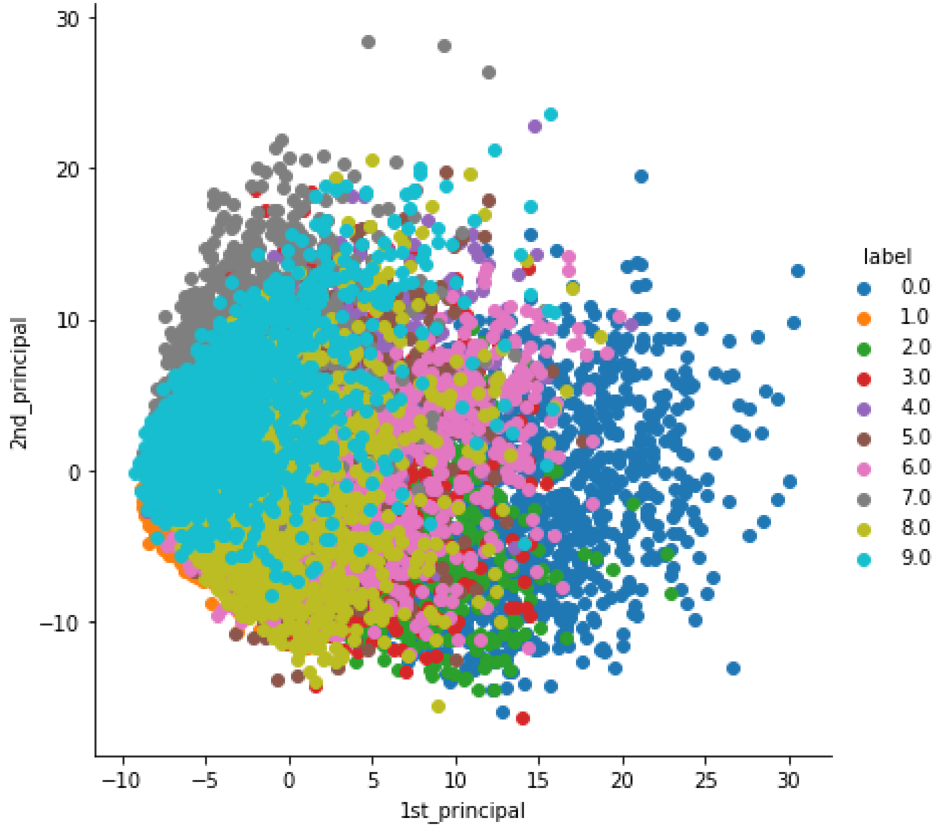
In [37]:
```
from sklearn import decomposition
pca = decomposition.PCA()
```

In [38]:
```
pca.n_components = 2
pca_data = pca.fit_transform(sample_data)

# pca_reduced will contain the 2-d projects of simple data
print("shape of pca_reduced.shape = ", pca_data.shape)
```

```
shape of pca_reduced.shape =  (15000, 2)
```

In [39]:

```python
pca_data = np.vstack((pca_data.T, labels)).T

# creating a new data fram which help us in ploting the result data
pca_df = pd.DataFrame(data=pca_data, columns=("1st_principal", "2nd_principal", "label"))
sn.FacetGrid(pca_df, hue="label", size=6).map(plt.scatter, '1st_principal', '2nd_principal').add_legend()
plt.show()
```



In [ ]: