**Project Title: 3D Printer Material Prediction Using Machine Learning**

**1. Introduction:**

3D printing is a modern technology that fabricates physical objects from digital models using a

variety of materials. The choice of material is crucial to ensure product quality and performance.

This project uses machine learning to predict the most suitable material type for 3D printing based

on given input features.

**2. Objective:**

To develop a machine learning model that can accurately predict the type of 3D printing material

based on certain measurable input features.

**3. Tools and Technologies Used:**

- Python

- Google Colab / Jupyter Notebook

- Pandas, NumPy

- Scikit-learn

- Matplotlib, Seaborn

**4. Dataset Overview:**

- The dataset contains various features that may influence material selection.

- It includes both categorical and numerical data.

- The target variable is assumed to be `Material\_Type`.

**5. Methodology:**

Step 1: Import Required Libraries

```python

import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

from sklearn.model\_selection import train\_test\_split

from sklearn.preprocessing import LabelEncoder

from sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import classification\_report, accuracy\_score, confusion\_matrix

```

Step 2: Load the Dataset

```python

df = pd.read\_csv('/path\_to/3D Printer Dataset.csv')

df.head()

```

Step 3: Data Exploration

```python

df.info()

df.isnull().sum()

df.describe()

```

Step 4: Encode Categorical Data

```python

label\_encoders = {}

for col in df.select\_dtypes(include=['object']).columns:

le = LabelEncoder()

df[col] = le.fit\_transform(df[col])

label\_encoders[col] = le

```

Step 5: Define Features and Target

```python

X = df.drop('Material\_Type', axis=1)

y = df['Material\_Type']

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size=0.2, random\_state=42)

```

Step 6: Train the Model

```python

model = RandomForestClassifier(n\_estimators=100, random\_state=42)

model.fit(X\_train, y\_train)

```

Step 7: Evaluate the Model

```python

y\_pred = model.predict(X\_test)

print("Accuracy:", accuracy\_score(y\_test, y\_pred))

print("

Classification Report:

", classification\_report(y\_test, y\_pred))

sns.heatmap(confusion\_matrix(y\_test, y\_pred), annot=True, cmap='Blues')

plt.xlabel('Predicted')

plt.ylabel('Actual')

plt.title('Confusion Matrix')

plt.show()

```

Step 8: Make Predictions on New Data

```python

sample = X\_test.iloc[[0]]

predicted\_material = model.predict(sample)

predicted\_label = label\_encoders['Material\_Type'].inverse\_transform(predicted\_material)

print("Predicted Material Type:", predicted\_label[0])

```

**6. Conclusion:**

The model provides a reliable method for predicting the appropriate material for 3D printing. Using

machine learning techniques such as Random Forest and Label Encoding, we are able to automate

material selection and enhance the manufacturing process.

**7. Future Work:**

- Integrate more features like cost, temperature, and weight tolerance.

- Test other ML models like SVM, Gradient Boosting, etc.

- Create a user interface for easier input and prediction.