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Blood Pressure Category Using Machine Learning

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Abstract
Blood pressure is an important measure of overall health, as abnormal levels can lead to serious conditions such as heart disease, stroke, and kidney failure. Regular monitoring is essential, but many individuals do not check their blood pressure frequently, increasing the risk of undetected hypertension. This study examines how various factors, including demographic details, medical history, lifestyle choices, emotional health, sleep patterns, and family history, influence blood pressure levels. The data was carefully processed by addressing missing values, converting categorical information into numerical form, standardizing numerical features, and dividing the dataset for analysis. Different methods were used to determine which factors have the strongest impact on blood pressure and to assess the accuracy of predictions. The results indicate that age, weight, stress levels, and medical history play a significant role, along with lifestyle habits such as diet, exercise, smoking, and alcohol intake. This study highlights the importance of understanding these factors for early detection and better management of hypertension. Future research can improve prediction accuracy by using larger datasets and incorporating more health-related variables.

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I. INTRODUCTION

Predicting Blood Pressure Using Machine Learning

Blood pressure is an essential measure of overall health, as abnormal levels can lead to serious conditions such as heart disease, stroke, and kidney failure. Many factors influence blood pressure, including age, weight, medical history, lifestyle choices, stress levels, and sleep patterns. Regular monitoring is necessary to detect changes early, but not everyone checks their blood pressure frequently. This can result in delayed diagnosis and an increased risk of health complications. Understanding how different factors affect blood pressure can help in early detection and prevention.

Machine learning is a powerful tool that can analyse large amounts of data to identify patterns and predict outcomes. In this study, we use machine learning algorithms to predict blood pressure based on various personal, medical, and lifestyle factors. By converting data into numerical form and applying different models, we aim to determine which method provides the most accurate predictions. This research highlights the potential of machine learning in healthcare, offering a data-driven approach to identifying individuals at risk of hypertension and helping with early intervention.

Data Collection

The dataset for this study includes different factors that can affect blood pressure. These factors are divided into six main categories:

Demographic Information: This includes details like age, gender, weight, and height. These factors help in understanding how a person's physical characteristics relate to their blood pressure.

Medical History: This section covers health conditions such as high blood pressure, diabetes, high cholesterol, heart disease, and kidney disease. It also includes whether the person is taking any medication to control blood pressure.

Lifestyle Factors: Daily habits can impact blood pressure. This section includes information about diet (healthy, average, or unhealthy), how often a person exercises, smoking habits, alcohol intake, and caffeine consumption.

Emotional Health: Stress can play a role in blood pressure changes. This section includes details about stress levels, ranging from very low to very high, and whether the person practices relaxation activities like meditation, yoga, or deep breathing.

Sleep & Rest: Sleep affects overall health, including blood pressure. This part of the dataset records how many hours a person sleeps each night and whether they have trouble or staying asleep.

Family History & BP Measurement: High blood pressure can run in families. This section includes information on whether close family members, such as parents or siblings, have a history of high blood pressure. It also asks how often the person checks their blood pressure and at what time of day.

Data Pre-processing

Before using the data for analysis, a few steps were taken to clean and organize it properly:

Handling Missing Data: Some entries in the dataset had missing values. These were filled using the median value for numerical data and the most common response for categorical data.

Changing Categorical Data to Numbers: Since some data was in words (like "Male " and "Female" or "Yes" and "No"), these were converted into numbers. For example, "Male" was given 1.This made it easier for the model to process the data.

Standardizing Data: Features like age, weight, and height had different numerical ranges. To make them uniform, the values were scaled so that no single factor dominated the predictions.

Dividing the Data: The dataset was split into two parts – 80% of the data was used to train the model, while 20% was kept separate for testing. This helps check how well the model works on new data.

Removing Unnecessary Data: Any repeated or unrelated information that did not affect blood pressure predictions was removed to keep the dataset clean.

Analysis

After preparing the data, different steps were taken to study how various factors affect blood pressure. The key steps included:

Checking Data Distribution: The values for age, weight, lifestyle habits, and medical conditions were reviewed to see how they were spread across the dataset. This helped in finding common trends.

Finding Relationships: The connection between different factors and blood pressure was checked. For example, people with high stress levels or a family history of hypertension were more likely to have high blood pressure.

Comparing Different Groups: Blood pressure readings were compared between different groups, such as men and women, smokers and non-smokers, and active and inactive people. This helped identify which groups were more likely to have high blood pressure.

Determining Important Factors: The most important factors affecting blood pressure were identified. Age, weight, stress levels, and medical history played a major role.

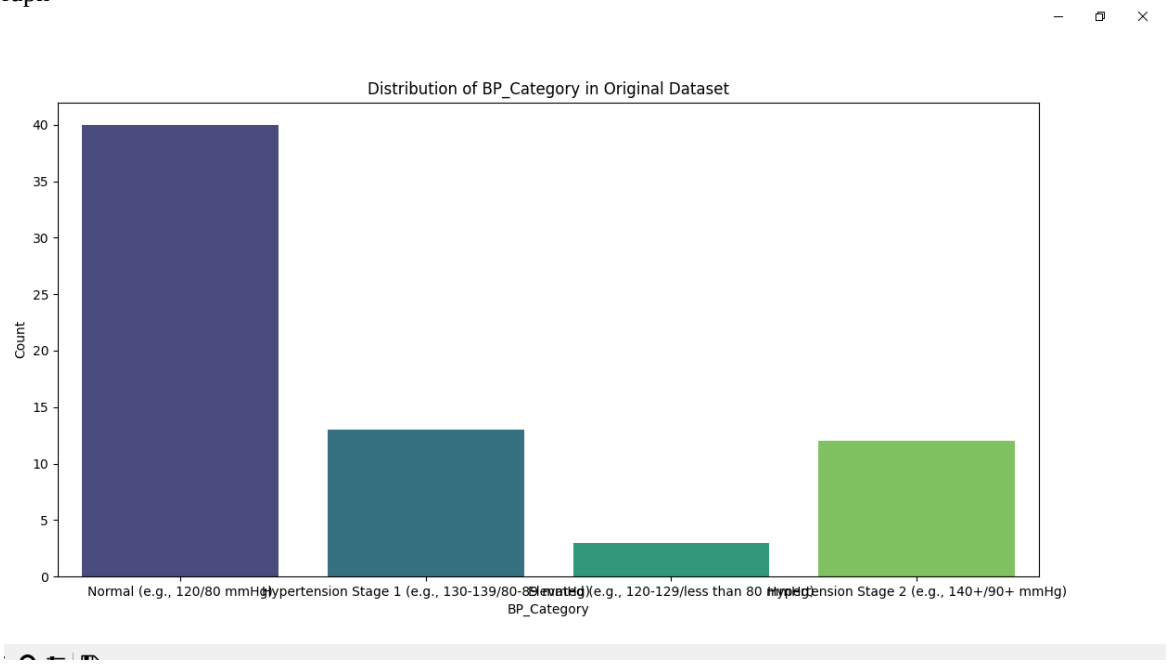
Testing Prediction Models: Different models were tested too predict blood pressure. Their accuracy was checked, and the best-performing model was selected.

Output

```
========== RESTART: D:/pyprg/bar1.py ==========

Original BP_Category Value Counts:
 BP_Category
Normal (e.g., 120/80 mmHg)                          40
Hypertension Stage 1 (e.g., 130-139/80-89 mmHg)     13
Hypertension Stage 2 (e.g., 140+/90+ mmHg)          12
Elevated (e.g., 120-129/less than 80 mmHg)           3
Name: count, dtype: int64

Model Performance:
Accuracy: 71.43%

Classification Report:
              precision    recall  f1-score   support

           0       0.00      0.00      0.00         1
           1       0.67      0.67      0.67         3
           2       0.67      1.00      0.80         2
           3       0.86      0.75      0.80         8
```

```
Model Performance:
Accuracy: 71.43%

Classification Report:
              precision    recall  f1-score   support

           0       0.00      0.00      0.00         1
           1       0.67      0.67      0.67         3
           2       0.67      1.00      0.80         2
           3       0.86      0.75      0.80         8

    accuracy                           0.71        14
   macro avg       0.55      0.60      0.57        14
weighted avg       0.73      0.71      0.71        14


New data loaded successfully!

✓ Predictions saved to 'category_predictions.csv'.
```

Graph



II. Conclusion

This study examined the factors that influence blood pressure and used machine learning models to predict it. The results showed that age, weight, stress levels, and medical history play a major role in determining blood pressure. Lifestyle habits such as diet, exercise, smoking, and alcohol consumption also have an impact.

By analysing these factors, it is possible to identify people at risk of high blood pressure early. The machine learning models used in this study provided useful predictions, which could help in monitoring and managing blood pressure more effectively. Future research can improve these models by using larger datasets and including more health-related factors for better accuracy.