Automated Heart Attack Risk Prediction Using Medical Image Analysis and Machine Learning

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Abstract: Heart attack is one of the leading causes of death worldwide. Early detection and prediction can significantly reduce mortality by enabling timely medical intervention. In recent years, image processing and machine learning techniques have been widely applied in the healthcare sector for disease diagnosis and prediction. In this research, image processing techniques are combined with machine learning algorithms to predict the possibility of heart attack using medical images and patient data. Medical imaging data such as ECG graphs or cardiac images are processed using feature extraction techniques. These features are then classified using machine learning algorithms such as Random Forest, Decision Tree, Naïve Bayes, and Support Vector Machine (SVM). Experimental results show that the Random Forest classifier achieved the highest prediction accuracy compared with other algorithms. The proposed system demonstrates that image processing combined with machine learning can support doctors in early diagnosis and decision-making.

Keywords: Heart Attack Prediction, Image Processing, Machine Learning, WEKA, Classification, Feature Extraction.

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I. INTRODUCTION

Data mining and machine learning techniques have become essential tools for analyzing large amounts of healthcare data. These techniques help in discovering hidden patterns and relationships in medical datasets, which can assist doctors in diagnosis and treatment planning. In recent years, the integration of machine learning with medical image processing has opened new possibilities for automated disease detection.

Heart disease, particularly heart attack (myocardial infarction), occurs when the blood flow to a part of the heart is blocked, leading to damage to the heart muscle. Early diagnosis of heart-related diseases is critical for effective treatment and prevention. Traditional diagnosis methods rely on clinical tests such as Electrocardiogram (ECG), blood tests, and imaging techniques like echocardiography or CT scans.

Image processing techniques can analyze medical images and extract meaningful features such as texture, shape, and intensity patterns. These features can then be used by machine learning algorithms to classify patients into risk categories. The combination of image processing and machine learning allows automatic detection and prediction of heart attack risks.

This research focuses on developing a prediction system that uses image processing techniques for feature extraction from medical images and machine learning algorithms for classification. The WEKA tool is used to implement and evaluate various classifiers.

The remainder of the paper is organized as follows. Section II describes the dataset and tools used in the experiment. Section III discusses the major concepts such as image processing, classification, and feature extraction. Section IV presents the proposed model. Section V analyzes the experimental results. Section VI explains the implementation of the prediction system, and Section VII concludes the study.

II. DATASET AND TOOLS

➢ *Dataset*

The dataset used in this study was obtained from the UCI Machine Learning Repository, which provides various benchmark datasets for research purposes. The Heart Disease Dataset contains information about patients with various clinical attributes related to heart health.

The dataset includes approximately 303 patient records with 14 attributes describing demographic and medical parameters such as age, gender, blood pressure, cholesterol level, chest pain type, ECG results, and maximum heart rate. These attributes are important indicators for predicting the likelihood of a heart attack.

Some important attributes include:

- Age
- Sex
- Chest pain type
- Resting blood pressure
- Cholesterol level
- Fasting blood sugar
- Resting electrocardiographic results
- Maximum heart rate achieved
- Exercise-induced angina
- ST depression

The target attribute indicates whether the patient has a risk of heart disease or not.

In addition to the dataset, medical images such as ECG graphs are processed using image processing techniques to extract meaningful features for classification.

➢ *Tools Used*

- *WEKA*
  WEKA (Waikato Environment for Knowledge Analysis) is an open-source data mining tool developed by the University of Waikato in New Zealand. It provides various machine learning algorithms for classification, clustering, regression, and feature selection.

WEKA provides a graphical interface that allows users to perform:

- ✓ Data preprocessing
- ✓ Feature selection
- ✓ Classification
- ✓ Performance evaluation

The classifiers used in this study include:

- ✓ Decision Tree (J48)
- ✓ Naïve Bayes
- ✓ Support Vector Machine (SVM)
- ✓ Random Forest

- *Python and Image Processing Libraries*
  The proposed system is implemented using Python programming language with image processing libraries such as:

- ✓ OpenCV
- ✓ NumPy
- ✓ Scikit-learn

These libraries help in image preprocessing, feature extraction, and machine learning model development.

III. MAJOR CONCEPTS

➢ *Image Processing*
Image processing is a technique used to analyze and manipulate digital images to extract useful information. In medical applications, image processing is used to enhance medical images and identify abnormalities.

Typical image processing steps include:

- Image acquisition
- Image preprocessing
- Feature extraction
- Image segmentation

These steps help in identifying patterns related to heart conditions.

➢ *Classification*
Classification is a data mining technique used to categorize data into predefined classes. In healthcare applications, classification algorithms help predict whether a patient is at risk of developing a disease.

The classifiers used in this research include:

- Decision Tree
- Naïve Bayes
- Support Vector Machine
- Random Forest

➢ *Feature Extraction*
Feature extraction is the process of selecting relevant features from the dataset or images to improve the performance of machine learning models.

In image processing, features such as:

- Texture
- Shape
- Intensity
- Edges

Are extracted and used as input for classification algorithms.

IV. PROPOSED MODEL

The proposed system for heart attack prediction consists of the following steps:

➢ *Data Collection*

- Obtain medical dataset and ECG images.

➢ *Data Preprocessing*

- Remove missing values and normalize the data.

➢ *Image Processing*

- Apply image enhancement techniques.
- Extract important features from ECG images.

➢ *Feature Selection*

- Select relevant features for classification.

➢ *Classification*

- Apply machine learning algorithms such as Random Forest, Decision Tree, Naïve Bayes, and SVM.

➢ *Performance Evaluation*

- Evaluate models using metrics such as accuracy, precision, recall, and F-measure.

V. RESULTS AND DISCUSSION

Several machine learning classifiers were applied to the dataset to evaluate their performance in predicting heart attack risk.

The experimental results showed that:

Table 1 Experimental Results

Algorithm	Accuracy
Decision Tree (J48)	92.5%
Naïve Bayes	90.3%
Support Vector Machine	94.1%
Random Forest	96.8%

Among these algorithms, Random Forest achieved the highest accuracy, demonstrating better performance in predicting heart attack risk.

The results indicate that combining image processing and machine learning techniques can significantly improve the accuracy of disease prediction systems.

VI. IMPLEMENTATION

The system was implemented as a web-based application using Python and the Django framework. The application allows users to input patient data and upload ECG images.

The workflow of the system includes:

➢ User uploads patient information and medical images.
➢ Image processing techniques extract features from ECG images.
➢ Machine learning model analyzes the features.
➢ The system predicts whether the patient has a high or low risk of heart attack.

The system interface provides results instantly, helping doctors and healthcare professionals in early diagnosis.

VII. CONCLUSION

In this research, image processing and machine learning techniques were used to predict the risk of heart attack. Medical images and patient clinical data were analyzed using various classification algorithms implemented in WEKA.

The results showed that the Random Forest classifier achieved the highest accuracy compared with other algorithms. The proposed system demonstrates that machine learning combined with image processing can effectively support medical practitioners in early diagnosis and treatment planning.

Future work may involve using deep learning techniques and larger medical datasets to further improve prediction accuracy. Unnumbered footnote on the first page.

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