SMART ECG ANALYSIS AND HEART CONDITION DETECTION USING AI

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Keywords:

Artificial intelligence, signal processing and healthcare management.

Introduction:

Heart diseases are among the leading causes of death globally, affecting millions of people every year. Early detection and proper diagnosis play a crucial role in preventing severe complications and saving lives. Electrocardiography (ECG) is a commonly used, non-invasive method to monitor heart activity and detect irregularities such as arrhythmias, heart attacks, and conduction issues.

However, manual analysis of ECG signals can be time-consuming, complex, and may lead to human error. It also requires trained medical professionals, which may not be available in all regions. To address these challenges, artificial intelligence (AI) is increasingly being used in healthcare applications, offering faster and more accurate results.

This project, "Smart ECG Analysis and Heart Condition Detection Using AI," focuses on developing a system that can automatically analyse ECG signals and detect possible heart conditions. The system uses machine learning techniques such as deep learning to recognise important features in ECG waveforms.

By training the model with both normal and abnormal ECG data, the system learns to classify different types of heart conditions. This approach reduces the need for manual interpretation and helps improve diagnostic efficiency. The aim is to support healthcare professionals in making faster and more reliable decisions.

Additionally, this solution can be useful in remote or rural areas where access to specialised care is limited. With further development, it may also be integrated into wearable health devices for continuous heart monitoring. Ultimately, the project seeks to make heart health management more accessible, reliable, and technology-driven.

Objectives:

- To develop an efficient system for processing and analysing ECG signals to detect heartbeats, rhythm abnormalities, and diagnose heart-related conditions accurately.
- To implement advanced signal processing techniques, such as noise filtering and feature extraction, for reliable ECG analysis.
- To integrate AI-powered algorithms for automated classification of heart conditions like arrhythmias, tachycardia, and bradycardia.
- To enhance diagnostic efficiency by providing real-time monitoring and reducing manual interpretation efforts.

Methodology:

1. **Collecting ECG Data:**

First, ECG data was collected from free and reliable online sources. The data included both normal heartbeats and abnormal heart conditions.

2. **Cleaning the Data:**

The raw ECG signals were cleaned to remove unwanted noise and errors. This step helped to improve the quality of the signals for better analysis.

2.Choosing Features:

Important parts of the ECG signals, like wave shapes and timing, were selected. These features help the AI model understand what a normal or abnormal heartbeat looks like.

4. Selecting an AI Model:

A machine learning model was chosen that can learn patterns from the ECG data. The model used techniques such as deep learning to automatically find useful patterns.

5. Training the Model:

The model was trained using many examples of normal and abnormal ECG signals. This helped the system learn how to tell the difference between different heart conditions.

6. Testing the Model:

After training, the model was tested with new ECG data to check how well it could classify the signals. The accuracy and performance were noted.

7. Classifying Heart Conditions:

Finally, the trained model was used to classify ECG signals into different categories, such as normal heartbeat, irregular rhythm, or other heart problems.

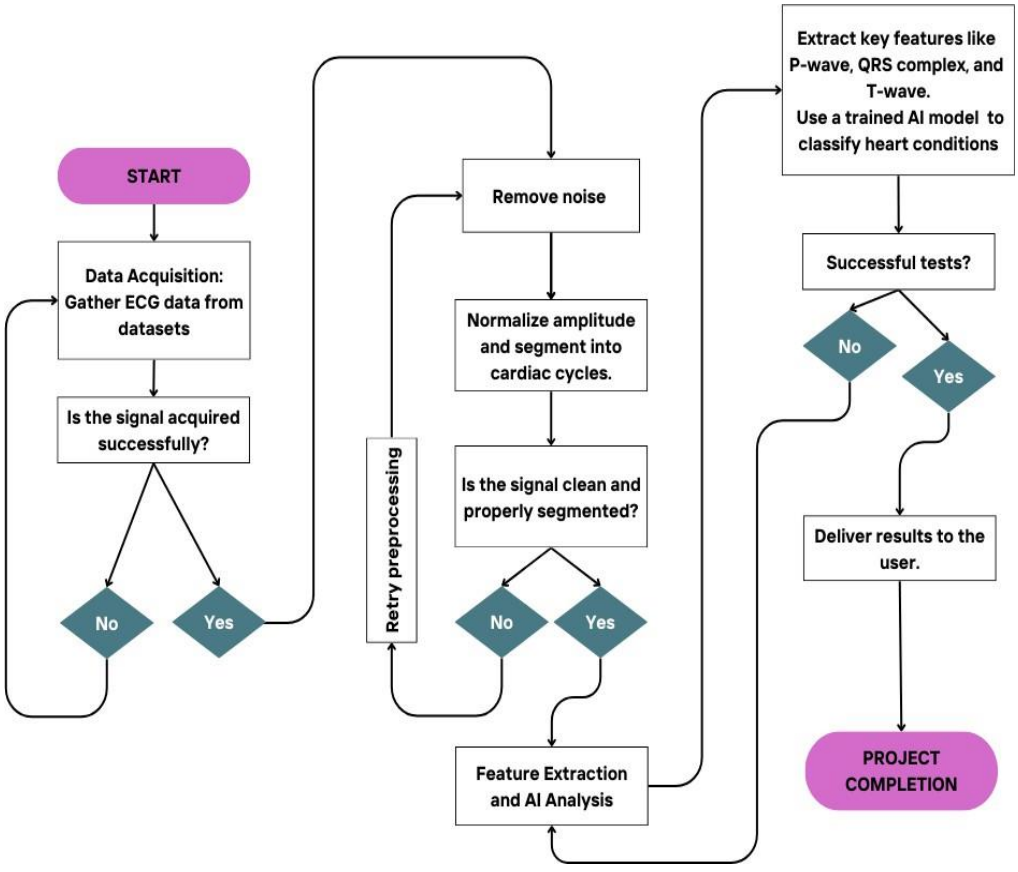

Figure 1: block diagram

Result and Conclusion:

The AI model successfully identified normal and abnormal heartbeats from the ECG data. It showed good accuracy in classifying different heart conditions, which indicates that the system can effectively support heart condition detection.

One key observation was that the model performed better when the ECG signals were cleaned and preprocessed properly. The results also improved with more training data, making the system more reliable.

In conclusion, the project demonstrated that AI can be used to analyse ECG signals and detect heart problems. With more advanced models and better data, such a system could be used in real-world applications like hospitals or wearable health devices to improve heart health monitoring.

In conclusion,

this project demonstrated that AI can effectively analyse ECG signals to detect heart conditions. The system was able to classify normal and abnormal heartbeats with good accuracy, showing the potential of AI in healthcare. With further improvements in data quality and model complexity, this approach could become a useful tool for real-time heart condition monitoring in various healthcare settings.

Future Scope:

- The project will focus on ECG signal analysis using preprocessing techniques to ensure clean and noise-free data for accurate results.
- The system will incorporate AI models for real-time automated diagnosis, supporting clinicians in making faster decisions.
- The framework will support single-lead ECG analysis, with scalability to include multi-lead ECG integration in the future.
- The system will be adaptable for further research and clinical use, allowing for integration with cloud-based services for remote monitoring and real- time data analysis.