This application performs ECG signal analysis, including PQRST peak detection, feature extraction, and arrhythmia classification.

✅ All source modules loaded successfully

# ECG Analysis Tool

## Welcome to the ECG Analysis Application

This application provides a comprehensive toolkit for analyzing ECG signals, with a focus on:

- **Signal Processing**: Clean and filter ECG signals
- **PQRST Peak Detection**: Identify important landmarks in ECG waveforms
- **Feature Extraction**: Extract statistical and morphological features
- **Visualization**: Interactive plotting of ECG signals and detected peaks

## Getting Started

1. Navigate to the **ECG Analysis** page to upload or generate ECG data
2. Process the signal to detect peaks and extract features
3. Use the **Visualization** page to explore the results in detail

## Data Sources

This tool works with ECG data from:

- CSV files with ECG signal data
- MIT-BIH Arrhythmia Database files (.dat, .hea, .atr)
- Synthetic ECG data generated within the app

## ECG Signal Example
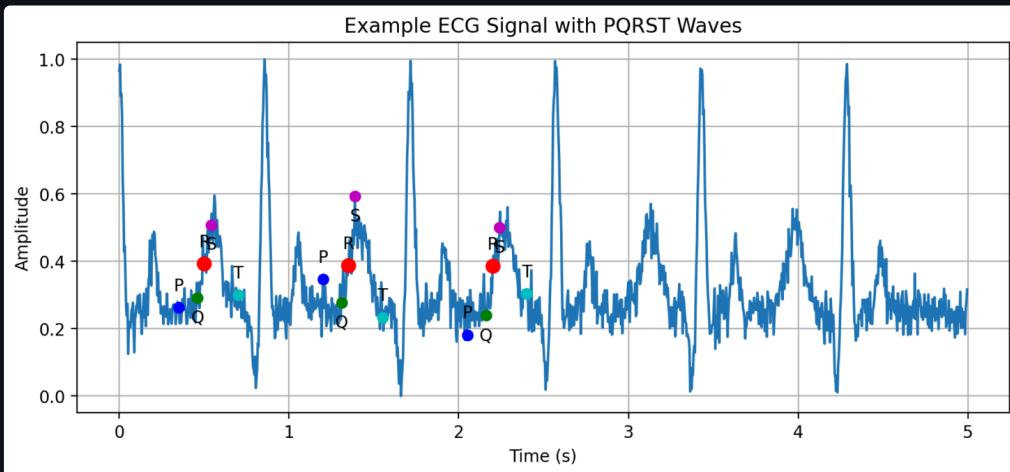


## Key Features

### Signal Processing

- Baseline wander removal
- Powerline interference filtering
- Bandpass filtering
- Signal normalization

### Peak Detection

- R-peak detection algorithms
- PQRST wave identification
- Heart rate calculation
- Interval measurements (PR, QRS, QT)

### Feature Extraction

- Statistical features
- Morphological features
- Frequency domain analysis
- Wavelet-based features

## About the Research

This application is part of a research project on ECG signal analysis and arrhythmia detection. The methods implemented here follow established signal processing techniques and novel approaches for feature extraction.

The key objectives of this research include:

1. Developing robust algorithms for ECG peak detection
2. Extracting clinically relevant features from ECG signals
3. Building a user-friendly tool for ECG analysis

For more information, please refer to our research paper or contact the research team.

⌄ Usage Instructions

### How to Use This Application

#### Data Input

- **Upload File**: Navigate to the Analysis page and upload your ECG data file (CSV, TXT, or DAT format)
- **Generate Synthetic ECG**: If you don't have real ECG data, you can generate synthetic signals for testing

#### Signal Processing

- Adjust filtering parameters to clean the signal
- Select R-peak detection method (Pan-Tompkins or XQRS)
- Process the signal to detect all PQRST peaks

#### Feature Extraction

- Extract heartbeats from the processed signal
- Generate statistical and morphological features

- Analyze feature distributions and correlations

## Visualization

- View the raw and processed signals
- Explore individual heartbeats and average patterns
- Analyze feature distributions and relationships

## Results

- Save analysis results for future reference
- Download data files and figures for further analysis