ABSTRAK

Riqqah Dewiningrum
ANALISIS PENGGUNAAN FILTER *INFINITE IMPULSE RESPONSE* (IIR) UNTUK MEREDUKSI *NOISE* PADA SISTEM *WEB-BASED VITAL SIGN MONITOR* (*ECG EXTREMITAS SIGN)*
xvii + 150 Halaman + 8 Tabel + 14 Lampiran

Penyakit jantung merupakan penyebab utama kematian secara global, sehingga pemantauan kondisi jantung secara *real-time* menjadi sangat penting, salah satunya melalui sinyal elektrokardiogram (ECG). Namun, sinyal ECG sering mengalami gangguan *noise* seperti *baseline drift* (<0,5 Hz) akibat pernapasan *dan power line interference* di sekitar 50 Hz, yang dapat menurunkan akurasi. Penelitian ini bertujuan untuk merancang dan menganalisis sistem pemantauan ECG berbasis *web* dengan penerapan filter digital *Infinite Impulse Response* (IIR) tipe *Chebyshev Type II* dan *Elliptic* guna meningkatkan kualitas sinyal melalui perbaikan nilai *Signal-to-Noise Ratio* (SNR). Akuisisi sinyal dilakukan menggunakan modul ADS1293 dengan Arduino Nano sebagai pengendali awal. Data kemudian dikirim ke Wemos Mega 2560 untuk ditampilkan secara *real-time* melalui layar Nextion dan dikirim ke *cloud* menggunakan ESP8266. Sistem diuji menggunakan enam *Lead* ECG pada beberapa kondisi dengan pengukuran BPM. Hasil menunjukkan bahwa sistem mampu menampilkan sinyal ECG dan nilai BPM secara akurat, dengan seluruh *Lead* memiliki tingkat *error* di bawah batas toleransi klinis (<2%). *Error* terendah tercatat pada *Lead* II, sedangkan *error* tertinggi sebesar 1.67% terjadi pada *Lead* aVL saat BPM 100. Analisis spektral menunjukkan bahwa sinyal ECG ideal memiliki distribusi energi dominan pada frekuensi 0.5–40 Hz, sementara *noise* utama berasal dari *baseline drift* dan interferensi daya sekitar 42.9 Hz beserta harmoniknya. Filter *Chebyshev Type II* dan *Elliptic* berhasil meningkatkan nilai SNR berdasarkan dua metode analisis. Pada FFT, SNR meningkat dari −8.803 dB menjadi −2,287 dB (*Chebyshev Type II*) dan −2.435 dB (*Elliptic*). Pada PSD, SNR meningkat dari −5.831 dB menjadi 5.907 dB (*Chebyshev Type II*) dan 7.126 dB (*Elliptic*). Berdasarkan hasil tersebut, filter *Elliptic* dinilai paling optimal karena menghasilkan peningkatan SNR tertinggi pada metode PSD yang lebih representatif.

Kata kunci: *Electrocardiogram (ECG), ADS1293, Infinite Impulse Response (IIR)), Signal To Noise Ratio (SNR), Internet Of Things (Iot).*
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ABSTRACT

Riqqah Dewiningrum
ANALYSIS OF INFINITE IMPULSE RESPONSE (IIR) FILTER IMPLEMENTATION FOR NOISE REDUCTION IN A WEB-BASED VITAL SIGN MONITORING SYSTEM (EXTREMITY ECG SIGNAL)
xvii + 150 *Pages* + 8 *Tables* + 14 *Appendices*

Heart disease is the leading cause of death globally, making real-time monitoring of heart conditions extremely important, one of which is through electrocardiogram (ECG) signals. However, ECG signals often experience noise interference such as baseline drift (<0.5 Hz) due to breathing and power line interference around 50 Hz, which can reduce accuracy. This study aims to design and analyze a web-based ECG monitoring system using digital Infinite Impulse Response (IIR) filters of the Chebyshev Type II and Elliptic types to improve signal quality by enhancing the Signal-to-Noise Ratio (SNR). Signal acquisition is performed using the ADS1293 module with an Arduino Nano as the initial controller. The data is then sent to the Wemos Mega 2560 for real-time display on the Nextion screen and transmitted to the cloud using the ESP8266. The system was tested using six ECG Leads under various conditions with BPM measurements. The results show that the system can accurately display ECG signals and BPM values, with all Leads having error rates below the clinical tolerance limit (<2%). The lowest error was recorded on Lead II, while the highest error of 1.67% occurred on Lead aVL at a BPM of 100. Spectral analysis showed that the ideal ECG signal has a dominant energy distribution at frequencies of 0.5–40 Hz, while the main noise originates from baseline drift and power interference around 42.9 Hz along with its harmonics. The Chebyshev Type II and Elliptic filters successfully improved the SNR value based on two analysis methods. In FFT, the SNR increased from −8.803 dB to −2.287 dB (Chebyshev Type II) and −2.435 dB (Elliptic). In PSD, the SNR increased from −5.831 dB to 5.907 dB (Chebyshev Type II) and 7.126 dB (Elliptic). Based on these results, the Elliptic filter was considered the most optimal because it produced the highest SNR improvement in the more representative PSD method.

Keywords: Electrocardiogram (ECG), ADS1293, Infinite Impulse Response (IIR)), Signal To Noise Ratio (SNR), Internet Of Things (Iot)
References: 42 journals (2019 - 2025)