

## ABSTRAK

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RANCANG BANGUN HOLTER MONITOR DENGAN INDIKASI *TACHYCARDIA*  
DAN *BRADYCARDIA* TAMPIL LCD NEXTION (IoT)

xix + 101 Halaman + 47 Gambar + 13 Tabel + 2 Lampiran

Holter Monitor adalah alat portabel berbasis baterai yang digunakan untuk merekam aktivitas listrik jantung secara kontinu selama 24–48 jam, terutama untuk mendeteksi gangguan irama seperti bradikardia dan takikardia saat pasien beraktivitas. Penelitian sebelumnya telah menggunakan teknologi seperti Bluetooth dan penyimpanan lokal, namun masih menghadapi kendala seperti konsumsi daya tinggi, keterbatasan durasi pemantauan, serta belum adanya fitur peringatan real-time. Penelitian ini mengembangkan Holter Monitor berbasis IoT dengan tampilan sinyal ECG Lead II secara real-time melalui LCD TFT Nextion, dilengkapi fitur klasifikasi kondisi jantung dan pengiriman data otomatis melalui internet. Sistem dirancang menggunakan mikrokontroler ESP32, rangkaian analog (instrumentation amplifier, HPF, LPF, notch filter, dan lainnya), serta sadapan Lead II (RA, LL, RL). Metode yang digunakan adalah pra-eksperimental dengan pendekatan “after only design” yang menilai performa alat setelah implementasi. Penghitungan BPM dilakukan dengan teknik pendeteksian puncak gelombang R, serta sistem buffer ganda untuk menjamin akurasi penyimpanan data. Hasil uji menggunakan Phantom ECG menunjukkan nilai error BPM sangat kecil, antara 0%–0,4%, jauh di bawah ambang batas 5%. Pengukuran pada responden dengan Pulse Oximeter menunjukkan error 0,2%–1,5%. Penyimpanan data dilakukan secara paralel ke SD Card dan website, dengan total 509 sampel terbaca selama 3 menit. Meskipun terdapat data loss pada pengiriman ke Excel karena kepadatan sinyal, tampilan website lebih konsisten dan real-time. Modul ini juga memberikan notifikasi otomatis berdasarkan kondisi BPM (normal, bradikardia, takikardia), serta menyimpan data per detik dalam format CSV yang mudah dianalisis di Excel. Antarmuka LCD dirancang agar ramah pengguna dan informatif. Kesimpulannya, alat ini berhasil menjalankan fungsinya sebagai Holter Monitor portable berbasis IoT yang akurat, hemat daya, dan terjangkau. Alat ini berkontribusi besar dalam mendukung pemantauan mandiri, penyediaan data medis terstruktur untuk diagnosis, serta pengembangan teknologi monitoring jantung jarak jauh di masa depan.

Kata Kunci: Holter Monitor, ECG, IoT, Nextion LCD, Takikardia, Bradikardia, ESP32

Daftar Pustaka: 25 Jurnal (2005-2024)

## ABSTRACT

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*DESIGN AND DEVELOPMENT OF A HOLTER MONITOR WITH TACHYCARDIA AND BRADYCARDIA INDICATION DISPLAYED ON NEXTION LCD (IoT)*

*xix + 101 Pages + 47 Pictures + 13 Tables + 2 Appendices*

*The Holter Monitor is a battery-powered portable device used to continuously record the heart's electrical activity for 24–48 hours, primarily to detect rhythm abnormalities such as bradycardia and tachycardia while the patient engages in daily activities. Previous studies have implemented technologies such as Bluetooth and local data storage, but these systems still face limitations such as high power consumption, restricted monitoring duration, and the absence of real-time alert features. This research presents the development of an IoT-based Holter Monitor capable of displaying real-time ECG Lead II signals via a Nextion TFT LCD, equipped with heart rate classification features and automatic data transmission via internet connection. The system is designed using an ESP32 microcontroller, analog circuitry (including instrumentation amplifier, high-pass filter, low-pass filter, notch filter, and others), and Lead II configuration (RA, LL, RL). A pre-experimental “after only design” method was used to evaluate device performance after implementation. BPM calculation was performed using R-peak detection techniques, with a double-buffer mechanism to ensure accurate data storage. Testing with a Phantom ECG showed a very small BPM error rate, ranging from 0% to 0.4%, well below the acceptable threshold of 5%. Measurements on human respondents using a Pulse Oximeter showed error rates between 0.2% and 1.5%. Data was stored in parallel to both an SD card and a website, with 509 samples recorded in 3 minutes. Although some data loss occurred in the Excel transmission due to signal density, the website display was more consistent and real-time. The module also provides automatic notifications based on BPM status (normal, bradycardia, or tachycardia) and stores data per second in a CSV format that is easy to analyze in Excel. The Nextion LCD interface was designed to be user-friendly and informative. In conclusion, the device successfully performs as an accurate, low-power, and affordable portable IoT-based Holter Monitor. This tool significantly contributes to independent health monitoring, structured medical data collection for diagnostic purposes, and the advancement of IoT-based cardiac monitoring technologies for future healthcare applications.*

*Keywords: Holter Monitor, ECG, IoT, Nextion LCD, Tachycardia, Bradycardia, ESP32*

*References: 25 Journals (2005-2024)*