**PulseX: AI-Based Stethoscope and ECG System for Early Cardiac Screening on Embedded Platforms**

Yassine BAZGOUR¹, Mohammed AMEKSA², Mohamed Amine CHADI²

¹ Semlalia Faculty, Department of Computer Science, Cadi Ayyad University, Marrakesh, Morocco  
² Cadi Ayyad University, UCA, Faculty of Science Semlalia, FSSM, Laboratory of Computer Science and Smart Systems, LISI, Marrakech Morocco

E-mail du contact : yassine.bazgour@gmail.com

Mots-clés: Artificial Intelligence, Heart Sound Analysis, ECG, Telemedicine, Embedded Systems

**Résumé**

Each year, over 7 million people worldwide die from heart diseases, with many cases linked to delayed or inaccessible early diagnostics. In Morocco, cardiovascular conditions account for nearly 38% of all deaths, underscoring the urgent need for scalable screening solutions. Addressing this critical gap, PulseX offers an innovative telemedicine system designed for early detection of cardiac anomalies, particularly suited to low-resource settings.

The PulseX architecture integrates stethoscope-based phonocardiogram (PCG) analysis and ECG signal recording into a compact, portable platform powered by a Raspberry Pi. Our methodology leverages a curated dataset of over 800 annotated heart sound recordings, enriched with key patient demographics such as age, gender, region, and smoking status. Audio data is transformed into Mel-spectrograms and combined with metadata to train deep learning models capable of both binary heartbeat classification and multi-label detection of cardiac risk patterns.

A ResNet-18 network serves as the backbone for classification, while an AD8232 ECG module captures additional heart activity for clinical review. The system’s intuitive user interface, PulseTrack, securely manages patient health records, collects demographic inputs, and visualizes diagnostic outcomes in real time.

Experimental results demonstrate that PulseX achieves 92% accuracy in distinguishing abnormal heart sounds, along with strong F1-scores and recall rates, validating its potential to support non-specialist health workers in frontline screening. By combining clinical data, accessible hardware, and robust machine learning algorithms, PulseX aims to democratize cardiovascular diagnostics, reduce preventable deaths, and pave the way for affordable, AI-driven telehealth initiatives across Morocco and similar regions worldwide.