

# A Free and Open-Source Web Application for Pulse Sequence Development and Simulation

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CHAPTER

Design, visualize, and simulate pulse sequences **directly from your browser**

## SUMMARY

### Motivation

- MRI sequence development has traditionally relied on **vendor-specific, proprietary tools**
- Limited accessibility, flexibility and reproducibility

### Recent Open-Source Initiatives

Several tools have contributed to a more open ecosystem:

- Pulseq**: standardized .seq format + Python/Matlab libraries
- JEMRIS**: simulator with graphical sequence editor
- CMRseq**: Python framework for programmatic sequence design
- mtrk**: newly-released, interactive and Pulseq-compatible sequence editor

### Our Contribution

**MRSeqStudio**: A Web-based, free and open-source application for:

- Designing sequences interactively – via drag and drop blocks
- Visualizing sequence waveforms – with a sequence diagram plot
- Displaying the selected slice within the 3D volume – through a lightweight spatial planner
- Simulating the created sequences in real time – using KomaMRI simulator backend

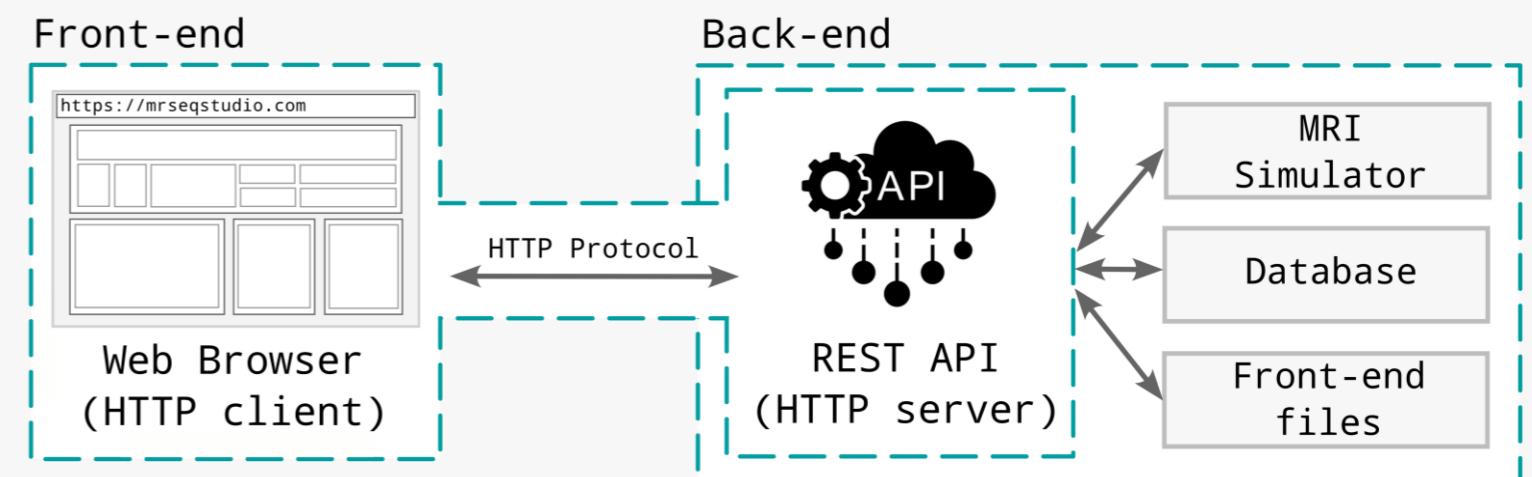
✓ Combines sequence editor + simulator in a single tool

✓ Runs entirely in the browser, with backend-powered simulations

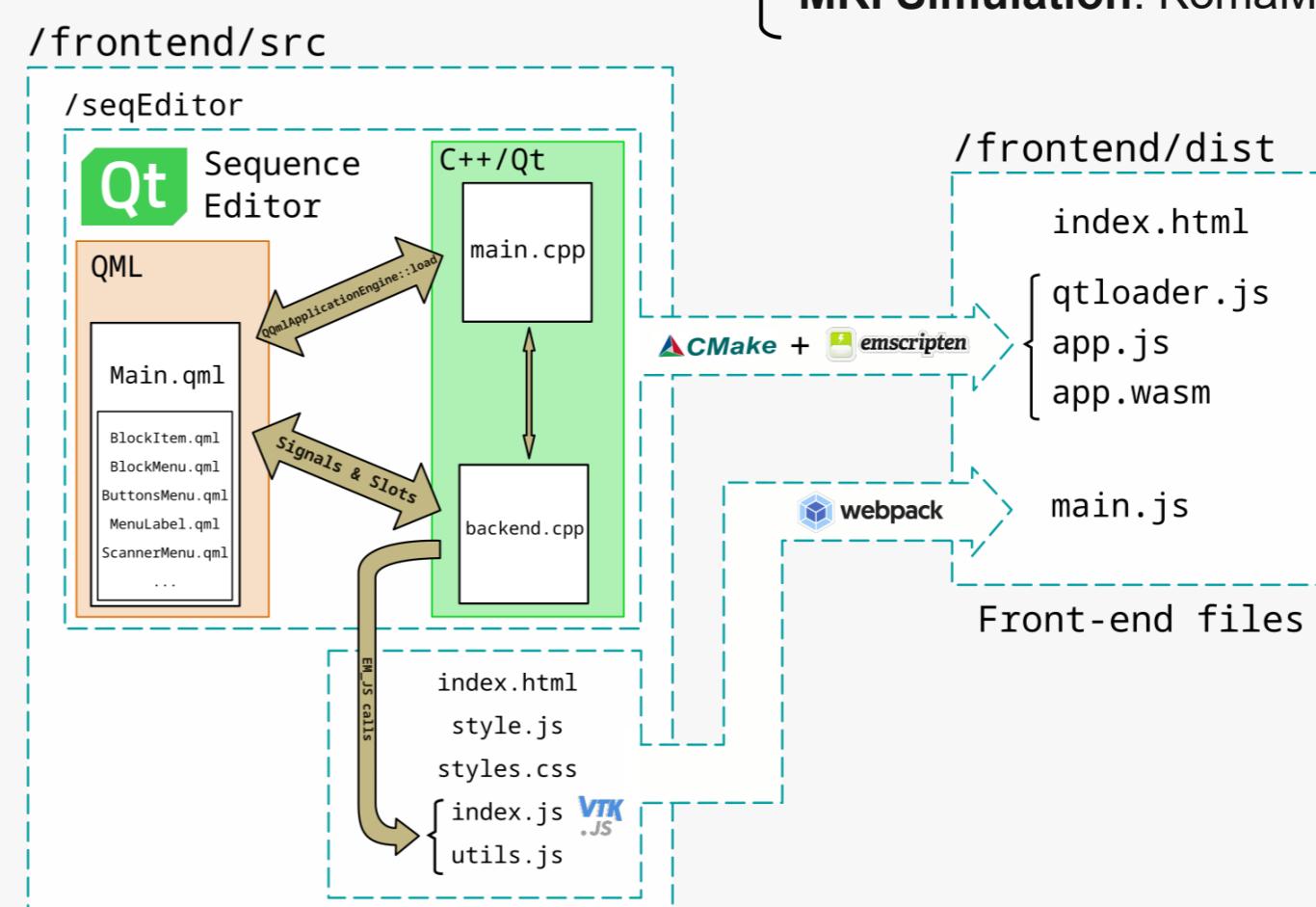
✓ **No local installations** needed

## METHODS

The application follows a client-server architecture based on the **REST** paradigm.



- Front-end**: built with **Qt** (QML) + WebAssembly, and **VTK.js**
- Back-end**: built with **julia** { REST API (HTTP server): Oxygen.jl   
 MRI Simulation: KomaMRI.jl }



github.com/pvillacorta/MRSeqStudio

## RESULTS

The screenshot shows the MRSeqStudio interface. It includes a sequence editor with a block-based interface for creating pulse sequences, a sequence diagram viewer, and a 3D slice viewer. The interface also features a simulation launcher, a 3D slice viewer, and a simulation result viewer. A QR code is in the bottom left corner, and a URL (https://mrseqstudio.lpi.tel.uva.es) is at the bottom.

**Usage example:**  
Adjusting TE and TR in a SE sequence to generate T1, T2, and PD-weighted images

**Key functionalities:**

- Sequence Creation, Editing and Simulation
- File Import and Export (.json, .qml)
- Plotting tools:
  - Sequence diagram viewer
  - 3D slice viewer

### Acknowledgements

The authors acknowledge grants PID2020-115339RB-I00, TED2021-130090B-I00 and PID2021-124407NB-I00 from the Ministerio de Ciencia e Innovación of Spain, and “la Caixa” Foundation and FCT under the project code [LCF/PR/HR22/0053].