Q'kay: a manager for the quality assessment of large neuroimaging studies

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Introduction

Despite substantial efforts toward improving the tools to carry out the visual assessment of quality, as well as automation, the quality control (QC) of imaging data remains an onerous, yet critical step of analysis workflows, especially within large-scale studies. Indeed, the reliability and reproducibility of results can be improved by implementing QC checkpoints throughout the workflow (Niso et al. 2022, Provins et al. 2023). Here, we introduce Q'kay, a web service to deploy rigorous QC protocols on large datasets leveraging the *individual reports* generated by tools like MRIQC (Esteban et al., 2017) and fMRIPrep (Esteban et al., 2019).

Methods

Data. We use the public dataset ds000030 (Gorgolewski et al., 2017), available at OpenNeuro (Markiewicz et al., 2021). We *preprocessed* all the T_1-weighted magnetic resonance imaging (MRI; n=265) with MRIQC (version 22.0.6), and made the generated visual reports available at https://mriqc.s3.amazonaws.com/index.html. A subsample of 30 visual reports was selected to evaluate Q'kay.

Design. Q'kay follows a model-view-controller architecture. The model involves a database implemented with MongoDB where users, datasets, and expert manual assessment ('ratings') for each assessed image are stored. The view (a graphical user interface accessible with standard web browsers uses the BootstrapJS library. The back-end, and the controller in particular, is implemented in Python and leverages the Flask framework. A login system with user roles ensures the control of access to the different parts of the web service, and importantly, keeps track of the progress of individual experts in rating their assigned cases. An *admin* role allows the management of quality assessment projects, datasets and their assignment to users. The admin can also configure projects to use shuffling of cases, as well as blinding (de-identification) to ensure objective rating settings. When used with MRIQC-generated visual reports, Q'kay also records the ratings in the database, allowing to monitor the progress in the assessments of individual expert raters.

Availability statement. Q'kay is available under the Apache 2.0 license at https://github.com/nipreps/qkay.

Results

Q'kay serves as an interface for visual inspections and manages the storage of the results.
Admins can access user management functions and assign datasets inspections to raters (See Figure 1). For each inspection, the option to anonymize and shuffle the visual reports is proposed to the admin. In the latter case, the random seed used for the shuffling is stored in the database in order to ensure the reproducibility and reversibility of the process. When the option *blind* is chosen, the individual reports are anonymized by removing the original images's identifiers and randomly reassigning subject indices.

The user panel provides an overview of all inspections assigned to the raters. The progression through the inspections is stored, allowing the raters to split their visual inspection sessions. When the raters select a report, they have access to a rating widget, on which they can indicate the overall quality grade of the images, the presence of artifacts, and their confidence level (See Figure 2). In addition to the ratings, Q'kay also keeps track of the time raters spend on each report.

Figure 1. Admin Panel. The admin panel is aimed at the management of users and datasets. The button "Assign dataset" allocates dataset inspections to raters. When the button is pressed, a new window opens where the admin can select options related to the inspection.

Figure 2. Rating widget. *The rating widget allows users to save the image quality grade assigned by the rater, the presence of artifacts, and their confidence level.The raters are allowed to submit ratings only after they moved one of the sliders.*

Conclusions

Q'kay enables fast and efficient implementations of QC protocols for large datasets. The front-end view of Q'kay eases and reduces the time cost of QC for raters. The database model allows efficient storage and extraction of the results. Q'kay will be used to assess the impact of removing facial features in expert quality assessment (Provins et al., 2022).

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