

A NodeJS application for XENON collaboration member management

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Abstract. The Big Science projects common of multi-institute particle-physics collaborations generates unique needs for member management, including paper authorship tracking, shift assignments, subscription to mailing lists and access to 3rd party applications such as Github and Slack. For smaller collaborations under 200 people, often no facility for centralized member management is available and these needs are usually manually handled by long-term members despite the management becoming untenable as collaborations grow. To automate many of these tasks for the expanding XENON collaboration, we developed the XENONnT User Management Website, a web application that stores and updates data related to the collaboration members through the use of Node.js and MongoDB. We found that web frameworks are so mature and approachable such that a student can develop a good system to meet the unique needs of the collaboration. The application allows for the scheduling of shifts for members to coordinate between institutes. User manipulation of 3rd party applications are implemented using REST API integration. The XENONnT User Management Website is open source and is a show case of quick implementation of utility application using the web framework, which demonstrated the utility of web-based approaches for solving specific problems to aid the logistics of running Big Science collaborations.

1 Introduction

The XENON collaboration has been conducting dark matter direct detection experiments situated at the INFN Laboratori Nazionali del Gran Sasso (LNGS) in Italy. Throughout its progression, the collaboration has continually advanced, constructing increasingly larger detectors incorporating dual-phase liquid xenon time projection chamber technology, from XENON10 [1], XENON100 [2], XENON1T [3] to the current-generation XENONnT [4], pushing the boundaries of WIMP dark matter detection [5–7]. During the process, the collaboration has expanded, adding more institutes and researchers. This growth is crucial to effectively operate the enhanced detectors and undertake data analysis tasks, but it also introduces an increased workload in administrative aspects that are typically helped by a 'project office' funded at 10% of the total project. The tasks undertaken include managing paper authorship, subscription to mailing lists, access to 3rd party applications such as Github and Slack, and notably coordinating shift assignments. As we have no central administrative resources, we were interested in how to automate and coordinate the collaboration through clever use of web apps and automation.

The types of challenges encountered with collaborator management in XENON has parallels for most smaller particle physics experiment. In the past, these management tasks were distributed among long-term members in the collaboration, resulting in significant variations in how these tasks were handled. For example, the status of collaboration members was recorded using a manually managed spreadsheet on a Google Sheet cloud platform overseen by a principal investigator (PI) in the collaboration. Through the years, this data source became unusable for automation as issues arose such as multiple date formats had been mixed and different ways of Romanizing names. And the GitHub administrator needed to add new members or remove previous members one by one after being informed of the status change. New collaborators required more than five accounts at on boarding at different institutions with different systems where all of these processes were manual, therefore slow and error prone. These procedures became laborious as the collaboration grew beyond one hundred members and more than 20 institutes. Moreover, the XENON collaboration, similar to many other smaller collaborations, lacks a managerial framework offered by established entities, such as national laboratories.

Given our success in using web frameworks for our data acquisition and monitoring systems [8], we wanted to explore the usage of web frameworks for solving simple yet unique and varied problems in experimental physics, as other collaborations have done for event visualization [9], project management [10] and data management [11–13]. Specifically, using web frameworks for digitizing custom administrative workflows. We developed a web application to integrate the administrative tasks into a single platform, automating numerous of processes, unifying the format of stored data and providing secured permission control. By employing open-source and freely available tools, we implemented the custom web application with low cost and hosted it within the existing infrastructure.

2 Features and Pages

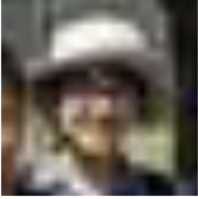
We begin by explaining the features that we require since this site is adapted to our specific needs. The "Profile" page manages user information and roles, while the "Institute List and Pages" offer details on collaborating institutes and member administration. "Forms" streamline user additions and removals, and the "Full Directory" provides comprehensive member tracking. Lastly, the "Shift Calendar" assists in efficient shift coordination.

2.1 Profile

The unit of our system is the user / collaboration member, where the first step is identifying how we will track collaboration members. It displays the logged-in user's contact information recorded in the database (name, email, phone number, etc.) and allows the user to update such details. The options to "Update Contact Info" opens a form as a modal which, on submission, makes a POST request which then updates the document in the users collection in the database that corresponds to the user that edited the profile.

From the profile page, one can also see specific roles that this user may perform. The "Pending Requests" tab is only available to authorized administrators responsible for on boarding. This interface allows an administrator to approve or deny user requests as each Institute PI can propose new members, where Pending Requests are discussed biweekly by PIs before being approved. When a user is approved, the document in the database that corresponds to that user has its "pending" field removed, and sets its "active" field to "true". If a user is denied, the corresponding document is removed from the database.

XENON COLLABORATION Institutes Full Directory Shifts Account ▾



Member since: Aug 01 2019

[Update Contact Info](#)

Shixiao Liang

PhD Student at Rice

👤 XENON Profile

CONTACT INFO

E-mail: liangsx@rice.edu

Skype: not set

Cell:

Percent Xenon: 100%

ACCOUNTS

GitHub ID: reallsx

LNGS ID:

[Join Slack](#)

[Request XENONIT Access](#)

[Request XENONnT Access](#)

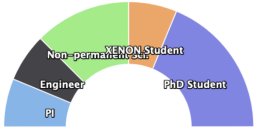
Figure 1. Example of profile page.

2.2 Institute List and Pages

The institutes page displays every university or national laboratory currently in the collaboration. Each institute’s page displays information about the institute including its current members, previous members, and a chart that represents statistics of the institute. On this page, the PI of the institute and any other administrator can add a new member to the institute or edit existing member information. These functions interact with the database to update or set new information.

XENON COLLABORATION Institutes Full Directory Shifts Account ▾

Rice XENON team at a glance



Current Members: 8

PI: Tunnell, Christopher

Members [Request New Member](#)

Current Members

Previous Members

- ▶ Bajwa, Waheed
- ▶ Higuera, Aaron
- ▶ Lee, Jason
- ▶ Li, Ivy
- ▶ Liang, Shixiao
- ▶ Peters, Christina
- ▶ Sanchez, Luis
- ▶ Tunnell, Christopher

Figure 2. Example of institute’s page.

2.3 Forms

Adding a new member is done by filling out the “Request New Member” form. When a new user is added to an institute, a document is created in the “users” collection with a “pending” status field and an email is sent to a specific email list that alerts other collaboration members of a new user pending for approval. This form is available in the “Forms” tab of the navigational menu. The second form on the website is named “Remove an Existing Member”. PIs are allowed access to this form, which should only display the names of members in their own institute, except for those with special permissions. In the form, the PI selects the name of the collaboration member to remove, which then auto-fills that user’s information from the database to assure that the correct user is being removed. Rather than remove the user document from the database, its “active” field is set to “false” and “end_date” is set for the user. An email is also sent to alert the collaboration that the user has left.

2.4 Full Directory

The full directory page provides a view of all the members in the collaboration in the form of a list, visually similar to the Google spreadsheet used previously. This view allows the PIs to edit members of their institutes or add members. Only a select group of people have the permission to edit every member on the list. There are multiple tables stored in this full directory to track “Current Members”, “Previous Members”, “Eng & Tech”, and “Previous Eng & Tech”. Users that are “pending” are not shown in any of the tables. When a user’s information is updated, a “last_modified” field is added to represent when the user was last updated. If that edit occurred less than a month ago, the row is highlighted, to indicate to all users that information has recently been updated.

2.5 Shift Calendar

The shift calendar page serves as a comprehensive platform where all tasks and activities related to shift coordination can be efficiently managed. This page has three main features: the institute leader board, calendar, as shown in figure 3, and shift management tab. The leader board uses data from the “shifts” collection in the database to display the number of total shifts taken by each institute for all time and number of shifts taken for the currently displayed year. The calendar exhibits shifts as contiguous blocks that extend across a specific time frame. These blocks indicate whether a given shift is currently available or has already been claimed by a member of the collaboration. Upon selecting an available shift, a user will be able to sign up for a shift or, if the user is a PI or operations manager, assign another member to the shift. Shifts can also be marked as available by a user or PI if necessary. The shift management tab is made available to a PI or operations manager user in order to add or remove available shifts in the calendar.

3 Design and Technology

The aforementioned features are implemented using open source or free tools. The key technologies that make up the functionality of this site are Node.js [14], Express [15], and MongoDB [16]. Node.js is a software platform that enables the use of JavaScript, which is mainly used for web development in browsers, for server-side and network applications. MongoDB is a NoSQL database, is adaptable and suitable for managing evolving, unstructured data, ideal for dynamic projects. The front-end of the website is built using the Embedded JavaScript Templating engine.

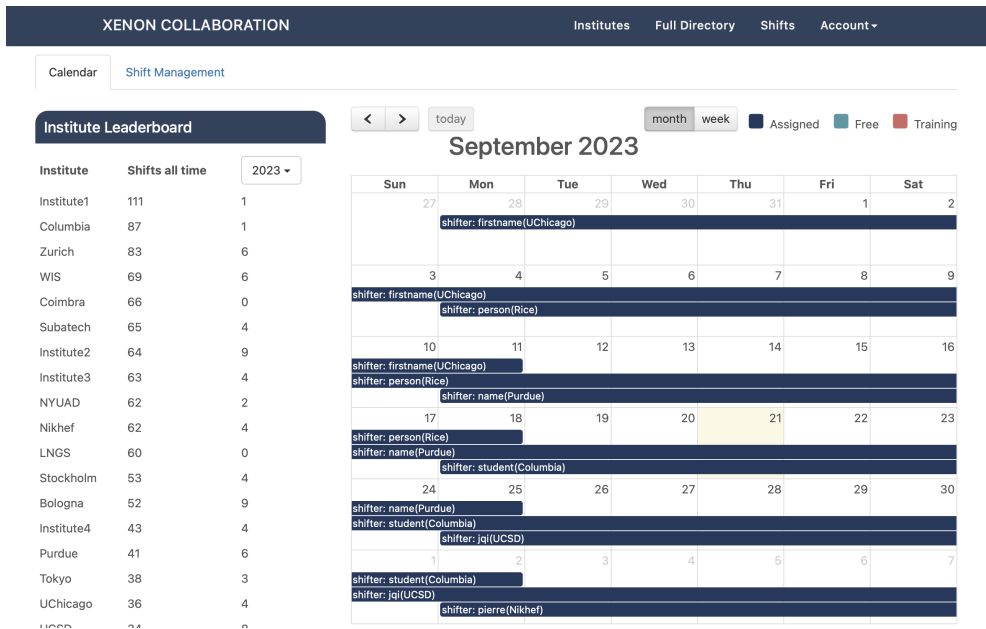


Figure 3. Snapshot of the shift calendar with the leader board on the left side and the calendar on the right side. The information has been altered for privacy purposes.

In addition, we use existing infrastructure to run the application. The database used for the application is the MongoDB database already in use by the collaboration for metadata related to data taking. The user management website is currently running on a server located at LNGS that is already hosting another web application for monitoring the data acquisition (DAQ) system [8] and the two web applications share the same DNS alias.

3.1 Frontend

The main appearance of the website is built with the Bootstrap 3 [17] framework and includes icons from Font Awesome [18]. The main elements of the website that are interactive such as the organization calendar, statistics graphs, and tables are built using JavaScript plug-ins. The calendar that is displayed on the page to manage shifts uses FullCalendar [19], which allows the calendar to display and update events. The tables displayed on the “full directory” page use the DataTables [20] jQuery plug-in, which includes simple user features such as a search bar and sorting option. Use of this API allows for the editing of the information for users without having to travel to a different site page. The charts shown on the pages for each institute are built using HighCharts [21]. All of these plug-ins retrieve and display information provided by the data from the database using jQuery and ajax requests.

The automated emails are handled using Nodemailer [22], a module for Node applications that automates email sent from an account, in this case from an LNGS Simple Mail Transfer Protocol account.

3.2 Database

The database used for this web application is a MongoDB database which has been in use for XENONnT data analysis. As the website was built with Node.js, the respective Node.js Mon-

goDB driver API was used to connect, read, and write to two main collections in the database: “users” and “shifts”. The “users” collection contains information of all user accounts (including names, email addresses, phone numbers, institutes, roles, etc.), which is also used in the DAQ website for displaying shifters’ contact information. The “shifts” collection contains information about all shifts taken and conducted by the collaboration institutes (including names of assigned shifters and specific dates of the shift). The common format of documents in these two collections are demonstrated in figure 4. Additional collections from the database in use for this site include “shifts_changelog” (stores information about edits to user information) and “shifts_calcs” (stores information per institute including the number of eligible members to be counted toward common fund calculations).

```

_id: ObjectId('5dc063f4c010e473538e1762')
last_name: "Liang"
first_name: "Shixiao"
institute: "Rice"
email: "liangsx@rice.edu"
start_date: 2019-08-01T00:00:00.000+00:00
percent_xenon: 100
position: "PhD Student"
lngs_ldap_uid:
daq_id:
active: "true"
lngs_ldap_cn: "Shixiao Liang"
lngs_ldap_email: "liangsx@rice.edu"
github: "reallsx"
github_home: null
picture_url: "https://avatars.githubusercontent.com/u/39665345?v=4"
cell:
favorite_color: "#000000"
skype: "not set"
groups: Array

_id: ObjectId('6299ca98fc348e166ccd5c77')
start: 2022-11-28T00:00:00.000+00:00
end: 2022-12-05T22:59:59.000+00:00
type: "shifter"
available: false
credit_multiplier: null
institute: "Rice"
shifter: "lsanchez"
comment: ""
multiplier: 1

```

Figure 4. Example of documents in "users" collection (left) and "shift" collection (right) in the MongoDB database.

3.3 Authentication

Authentication for the site is handled with the middleware Passport.js [23], which allows for multiple forms of authentication. The three forms of log-in authentication for the site use local (email), LDAP, and GitHub. In addition to the use of GitHub’s OAuth 2.0 API, the GitHub REST API client for JavaScript (Octokit [24]) is used to ensure that the user part of the XENONnT or XENONIT experiment GitHub organizations. Through a user account, the site manages permissions of collaboration members by storing those labeled permissions as an array field of a document in the database for each appropriate user. When a user attempts to log in, the MongoDB database is used in a request to verify that the user’s information exists. Upon success of that request, the user is allowed to access the features of the site, with some restricted to those with specific roles (PIs).

4 Lessons Learned and Conclusion

We developed a web application for the XENON collaboration using JavaScript and other common web technologies. This application consolidates information related to administrative processes into a unified system accessible to collaboration members.

The initial iteration of the web application was developed by an undergraduate student majoring in computer science during a summer break without previous web experience. Subsequent maintenance and continued development efforts were undertaken by undergraduate

students with limited oversight from PIs and graduate students. In addition to serving as a cost-efficient management solution, the project also afforded valuable learning opportunities for undergraduate students.

Future development of the web application could include REST API integration via Github Octokit in order to facilitate automated removal of members from the Github organizations related to the collaboration. Further additions to the site can also be made to also automate the addition and removal of member addresses to and from collaboration mailing lists.

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