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Web Framework

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Abstract

The purpose of this paper is to demonstrate how to extend a web framework (WF) for developing web apps that can meet the diverse needs of different fields. This work aims to provide computer science senior project students with an opportunity to work on a wide range of projects using Apache, HTML, CSS, JavaScript, PHP, and MySQL. The paper presents a WF that manages jokes, based on the book PHP & MySQL: Novice to Ninja (6th ed.) by T. Butler and K. Yank. The WF is interactive, responsive, secure, password-protected and database-driven. It consists of generic and specific components that use a MySQL database on the web server-side to store jokes. The specific components can be modified or added to create custom apps. Admin users can log in with their email and password and perform various actions (view, add, delete and edit) on jokes and categories, depending on their level of permission. Admins with full permissions can also edit the permissions of other registered accounts and access the Manage Categories, Manage Jokes, and Manage Authors pages. The original WF is enhanced and expanded for the senior project starting point by adding the following features: a hierarchical main menu with admin menus as the second level, a highlighted selected menu item, responsive design - accessibility on all devices, improved password security (minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digit, 1 special character), a two-factor authentication security subsystem, cascaded deletion and uploaded and retrieved binary files (images and documents). In conclusion, the project is designed and implemented following the best practices and tested on a web hosting server provider.

Introduction

Let’s introduce the key web-related terms:

A *framework* [Code Academy (2023)] is a structure that one can build software on. It serves as a foundation, so one is not starting entirely from scratch. Frameworks are typically associated with a specific programming language and are suited to different types of tasks.

A *Web Framework* or *Web Application Framework* [Web Framework – Wikipedia (2023)] is a software framework that is designed to support the development of web applications including web services, web resources, and web APIs. Web frameworks provide a standard way to build and deploy web applications on the World Wide Web.

There are two groups of web application frameworks: one helps to set up app logic on the server, the other – on the client [Yaskevich A. (2017).] There are client-side frameworks, such as: Bootstrap, React.js, Angular.js, Backbone.js, Semantic-UI. Among the most popular based server-side web frameworks are: Symfony (PHP), Django (Python), Express (Node.js/JavaScript), Ruby on Rails (Ruby), ASP.NET (C#). By using either of these server-side web application frameworks, it handles HTTP requests, database control and management, as well as URL mapping and render view data with a server. Web frameworks above don't have fully open documentation on how to develop a step-by-step framework for competition reasons. In the paper below, it is shown how 16 features are added to the existing framework. The existing framework has step-by-step development documentation and code [Butler, T., & Yank, K. (2017)].

The main goal of the senior project course (CMPS 499) in many universities is to provide a capstone experience in which the student combines knowledge, skills, and topics that the student already learned with some new learned topics during the course. In addition, students need to have a senior project presentation and write a final project report. All computer science undergraduates are required to take a capstone course senior project at La Verne University and many other universities [Computer Science Curricula (2013)].

Moreover, the senior project course (CMPS 499) at the University of La Verne satisfies the following Program Criteria for Computer Science student outcomes [Accreditation Board for Engineering and Technology – ABET (2022-2023)] as follows:

- Ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- Ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Ability to communicate effectively in a variety of professional contexts.
- Ability to apply computer science theory and software development fundamentals to produce computing-based solutions.

Before starting work on a senior project, in another class (CMPS 320 - Internet Apps Development), students learn how to construct dynamic, data-driven web applications, and secure, customized content management systems using PHP and MySQL. Students develop skills in many aspects of the software development and deployment process. Students develop basic and intermediate skills in structured Query Language (SQL), MySQL, development using PHP, form processing, and regular expressions. The main focus is to apply principles and techniques needed to build a professional web application using PHP & MySQL. This is achieved by gradually introducing the design and implementation of a Web Framework (WF) [Butler, T., & Yank, K. (2017)]. The WF keeps track of entered jokes. This approach allows for a practical understanding of these technologies in the context of a real-world application. Keeping track of different entities is indeed an important problem and can be very useful for monitoring events. The goal of the paper is to showcase many new additions and features to the framework that were successfully added or modified to achieve a well-structured, more secure, and elegant Expanded Web Framework (EWF). This EWF has the capability to upload, update, and delete images associated with keeping track of jokes. By doing so, students will have a broader spectrum of possibilities to expand the WF to meet their individual project needs and satisfy the requirements of their senior project.

The project [Miranda-Hill, W., Goetz, J. (2019, June 30 – July 4)] aims to prototype the functionality of a user-generated geospatial meteorology map (for keeping track of temperature and pressure) based on a low code interactive framework [Butler, T., & Yank, K. (2017)].

The Patient Care Reporting App [Guarrera, A., Goetz, J. (2022, May 10)] is also based on the same interactive framework [Butler, T., & Yank, K. (2017)].

An additional project [Grime, C., Goetz, J. (2023)] based on the same framework is the Course and Faculty Management System (CFMS) which allows educational organizations to efficiently organize and manage their courses and faculty. The basic goal of CFMS was to keep track of courses and faculty by managing (i.e., viewing, adding, editing, deleting) Courses, Instructors, Subjects, Departments, Timeslot, Course Attributes with given constraints for each entity.

Another project [Flores Marquez, A., Goetz, J. (2023)] based on the same framework is the Certificate Management Application. Its goal was to develop a web application that keeps track of recipients of computer science certificates by managing (viewing, adding, editing, deleting) Certificates, Recipients, Courses, Categories, and setting the users permissions.

Problem Statement

The purpose of the paper is to show how to expand WF [Kevin Yank, Tom Butler 2017] in order to develop a web app for the broad needs of different fields. The framework hosts many users, which can have access from different clients at the same time.

The web application includes administration capabilities, which allow administrators to set permissions for users and edit, delete, and insert jokes and categories. The website consists of multiple web pages that limit accessibility depending on the permissions set for the user by the administrator. Super administrators with all permissions have access to all pages including, Manage Jokes, Manage Categories, and Manage Authors.

The original Web Framework [Butler, T., & Yank, K. (2017)] has been expanded with the following *features* that were not present in the original one:

1. Responsive design to allow the app to be accessible on all devices.
2. An extended password security (minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digit, and 1 special character).
3. Forget or change a password feature.
4. Limitation on how many times a wrong password can be entered.
5. A two level of authentication security subsystem with a temporary password (token) sent to the user's email address.

6. Display of the current user name next to the main menu item “Log out” after a successful log-in.
7. Ability of logged-in users to upload, update and delete photos from the Web Framework and to keep track of them. Ability to upload, update and delete binary files from the database.
8. Integration of the Add Joke and List Joke menus into a new menu item Manage Joke.
9. Integration of the Add Category and List Category menus into a new menu item Manage Joke.
10. Hierarchical main menu with admin menus as the second level.
11. Text-based navigation.
12. Dynamic posting of a copyright symbol with a year.
13. Highlighting of the selected main menu item.
14. Highlighting of the selected category name.
15. Issuing of a confirmation message when any record is deleted.
16. Options to display the latest records at the end or to display them in alphabetical order for all category orders for Manage Joke and Manage Category menus.

The goal of this project is to add to the web application features discussed above and keep track of jokes by managing (i.e., viewing, adding, editing, deleting) jokes, managing (i.e., viewing, adding, editing, deleting) categories and setting the author’s permissions. As **a** result, Expanded Web Framework (EWF) was created.

System Design

Design Overview

Expanded Web Framework (EWF) is a full-stack web-based application consisting of three main components. The three components are the user interface, the server, and the database. The technology stack currently used by the EWF is HTML, CSS, JavaScript, PHP, and MySQL.

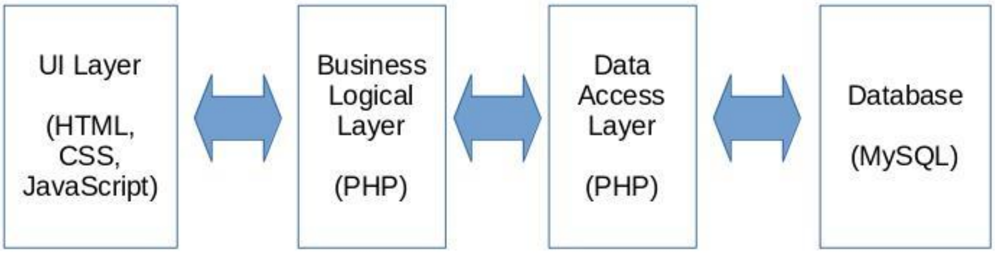


Figure 1. Framework Logical Layers (FLL)

The framework logical layer (LCF) architecture consists of three functional layers (see Figure 1):

- *User Interface (UI) Presentation Layer,*
- *Business Logical Layer (BLL), and*
- *Data Access Layer (DAL).*

The front-end user interface (UI) layer of this application is designed to display web pages on the client side. These pages are rendered using HTML, CSS, and JavaScript [Deitel, P. J., Deitel, H. M., & Deitel, A. (2012)], which are generated on the server side. The UI provides users with the ability to view, add, update, and delete data related to jokes and their associated categories.

The components of the web application interface are dynamically generated using the template engine provided by the PHP framework. This application also incorporates a permission-based access system, which is utilized to generate and display only the user interface elements that are relevant to the active user [Grime, C., Goetz, J. (2023)].

The back-end server components (BLL and DAL) of the application are written in PHP, and the server application is built on a PHP framework. This framework offers methods for connecting to a MySQL database and executing queries on the connected database. The server application not only performs calculations on data but also adds, deletes, or modifies data in the database. The system is designed to prevent SQL injection by malicious users, thereby preventing the execution of undesired code in the web application. The PHP framework includes a routing system that enables the server to handle GET, POST, and PUT requests. Owing to its robustness and flexibility, this framework can be used to build a wide variety of web applications [Grime, C., Goetz, J. (2023)].

The final component is a MySQL Server, which serves as the application's Relational Database Management System (RDBMS). However, it's considered a third-party application and not a logical layer [Azma, H., Goetz, J. 2007]. The RDBMS is used to store data, and the web application's back-end connects to and interacts with it using SQL queries. The foundation for this functionality is provided by the framework and is expanded upon in the Expanded Joke Management System (EJMS), which is equivalent to EWF. The original framework is referred to as the Internet Joke Database (IJD).

User Interface Layer

The graphical user interface (GUI) is designed to allow interaction with graphical controls through direct manipulation, enabling users to view, add, delete, or edit information about the Expanded Joke Management System. These interfaces allow users to interact with the system and manage various aspects of the content.
The website adheres to the [Web Design Best Practices Checklist (2023)].

Sitemap

Figure 2 illustrates the hierarchy of the website. The first level represents the web pages accessible to users who are not logged in, while the second level represents the pages accessible to logged-in users. However, access to some features is restricted based on the user's privileges; for instance, only admins can access the 'Manage Jokes', 'Categories', and 'Authors' pages.

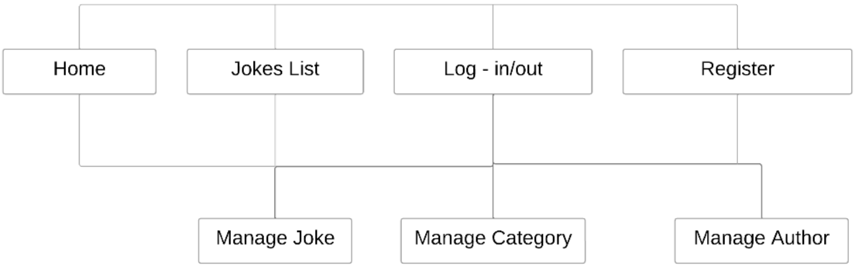
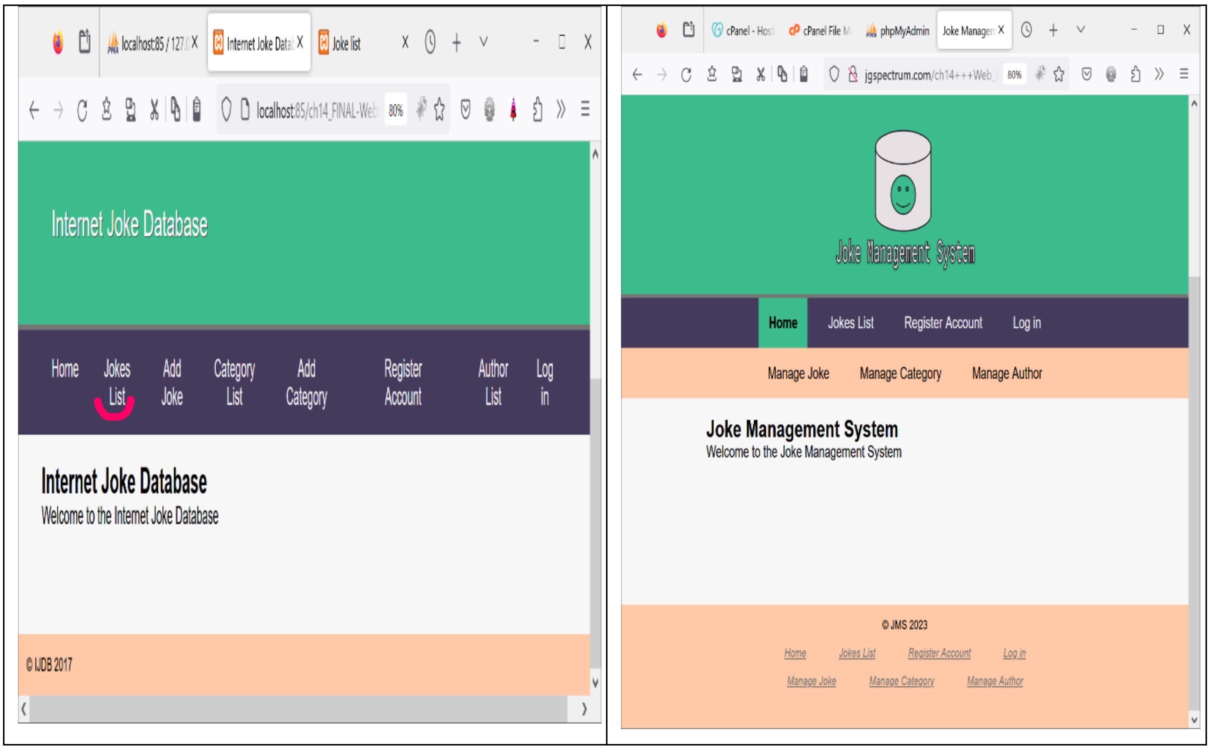


Figure 2. Website map

The Internet Joke Database (IJD) and the Expanded Joke Management System (EJMS) consist of two main components: the public and admin components. Figure 3 displays the public functionality and menu for both IJD and EJMS. The Expanded Joke Management System (EJMS) can be accessed via the website [Goetz, J. (2023)]. The public user interface of IJD and EJMS includes the following sections: header, menu, aside, main content area, and footer. Notably, in EJMS, a logo with the description 'Joke Management System' has been added, the selected menu item is highlighted with a green background, text-based navigation has been introduced, and a copyright symbol with the current year is dynamically displayed.



Internet Joke Database

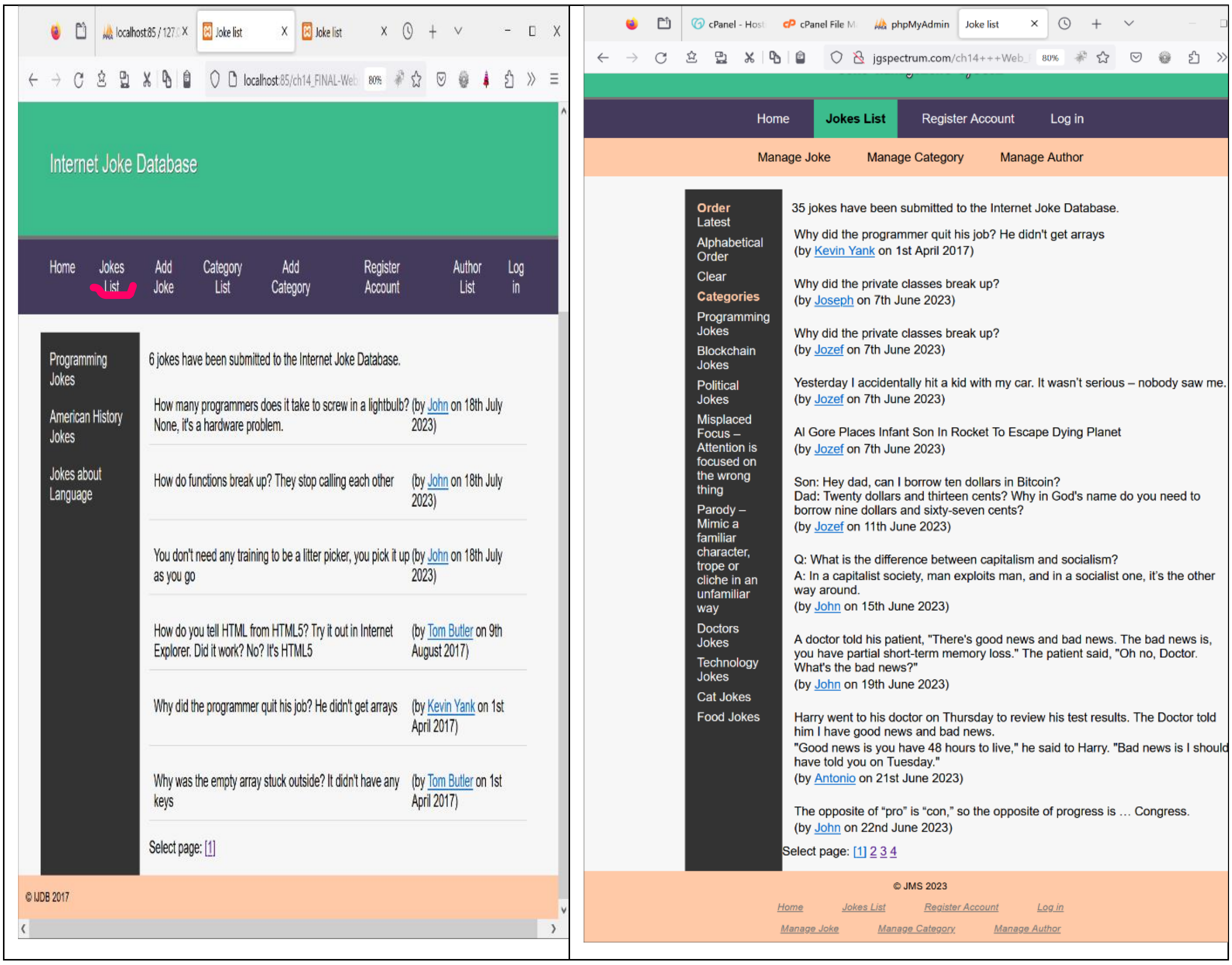
Welcome to the Internet Joke Database

Joke Management System

Welcome to the Joke Management System

Figure 3. IJD and EJMS - Public component of the Home page

All public entities, such as the Jokes List, are available for viewing only and do not include interactive buttons such as 'add', 'edit', or 'delete' (refer to Figure 4).



Internet Joke Database

Home | Jokes List | Add Joke | Category List | Add Category | Register Account | Author List | Log in

Programming Jokes
American History Jokes
Jokes about Language

6 jokes have been submitted to the Internet Joke Database.

How many programmers does it take to screw in a lightbulb? None, it's a hardware problem. (by John on 18th July 2023)

How do functions break up? They stop calling each other (by John on 18th July 2023)

You don't need any training to be a litter picker, you pick it up as you go (by John on 18th July 2023)

How do you tell HTML from HTML5? Try it out in Internet Explorer. Did it work? No? It's HTML5 (by Tom Butler on 9th August 2017)

Why did the programmer quit his job? He didn't get arrays (by Kevin Yank on 1st April 2017)

Why was the empty array stuck outside? It didn't have any keys (by Tom Butler on 1st April 2017)

Select page: [1]

© IJDB 2017

Home | Jokes List | Register Account | Log in

Manage Joke | Manage Category | Manage Author

Order
Latest
Alphabetical Order
Clear
Categories
Programming Jokes
Blockchain Jokes
Political Jokes
Misplaced Focus – Attention is focused on the wrong thing
Parody – Mimic a familiar character, trope or cliche in an unfamiliar way
Doctors Jokes
Technology Jokes
Cat Jokes
Food Jokes

35 jokes have been submitted to the Internet Joke Database.

Why did the programmer quit his job? He didn't get arrays
(by Kevin Yank on 1st April 2017)

Why did the private classes break up?
(by Joseph on 7th June 2023)

Why did the private classes break up?
(by Jozef on 7th June 2023)

Yesterday I accidentally hit a kid with my car. It wasn't serious – nobody saw me.
(by Jozef on 7th June 2023)

Al Gore Places Infant Son In Rocket To Escape Dying Planet
(by Jozef on 7th June 2023)

Son: Hey dad, can I borrow ten dollars in Bitcoin?
Dad: Twenty dollars and thirteen cents? Why in God's name do you need to borrow nine dollars and sixty-seven cents?
(by Jozef on 11th June 2023)

Q: What is the difference between capitalism and socialism?
A: In a capitalist society, man exploits man, and in a socialist one, it's the other way around.
(by John on 15th June 2023)

A doctor told his patient, "There's good news and bad news. The bad news is, you have partial short-term memory loss." The patient said, "Oh no, Doctor. What's the bad news?"
(by John on 19th June 2023)

Harry went to his doctor on Thursday to review his test results. The Doctor told him I have good news and bad news.
"Good news is you have 48 hours to live," he said to Harry. "Bad news is I should have told you on Tuesday."
(by Antonio on 21st June 2023)

The opposite of "pro" is "con," so the opposite of progress is … Congress.
(by John on 22nd June 2023)

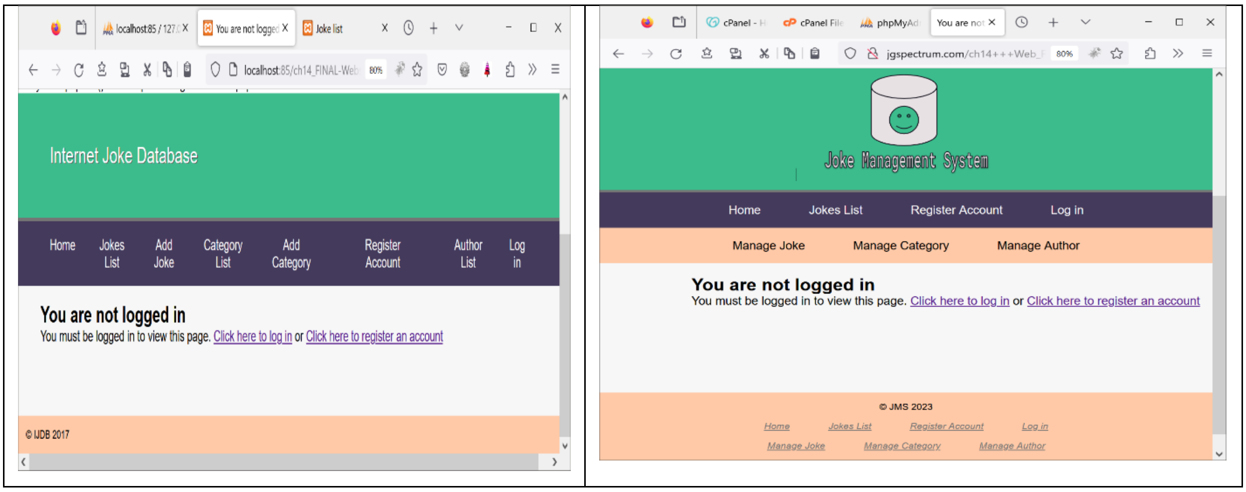
Select page: [1] 2 3 4

© JMS 2023

Home | Jokes List | Register Account | Log in

Manage Joke | Manage Category | Manage Author

Figure 4. IJD and EJMS - The public component of the Joke List page



Internet Joke Database

Home | Jokes List | Add Joke | Category List | Add Category | Register Account | Author List | Log in

You are not logged in

You must be logged in to view this page. Click here to log in or Click here to register an account

© IJDB 2017

Joke Management System

Home | Jokes List | Register Account | Log in

Manage Joke | Manage Category | Manage Author

You are not logged in

You must be logged in to view this page. Click here to log in or Click here to register an account

© JMS 2023

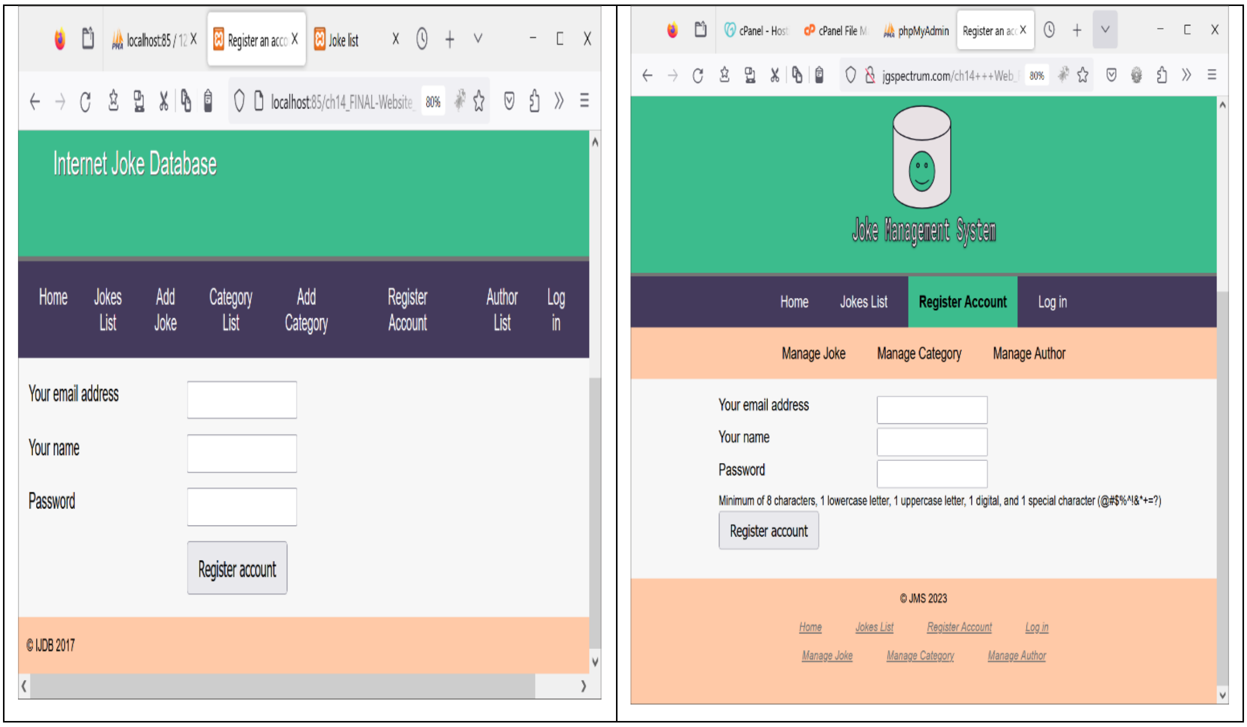
Home | Jokes List | Register Account | Log in

Manage Joke | Manage Category | Manage Author

Figure 5. The public component of the Joke List, Add Joke, Category List, Add Category, Author List page for IJD and Manage Joke, Manage Category and Manage Author for EJMS

Figure 5 illustrates the public components of the Joke List, Add Joke, Category List, Add Category, and Author List pages for IJD. It also shows the equivalent Manage Joke, Manage Category, and Manage Author pages for EJMS. If a user who is not logged in attempts to click on any of these menus, they will be informed with a message stating "You are not logged in". This ensures that only authorized users can access certain features of the system.

The password for EJMS requires a minimum of 8 characters, including at least 1 lowercase letter, 1 uppercase letter, 1 digit, and 1 special character (as shown in Figures 6 and 7). Additionally, there is a “Forget or change a password” button as depicted in Figure 8. These features enhance the security of the system.



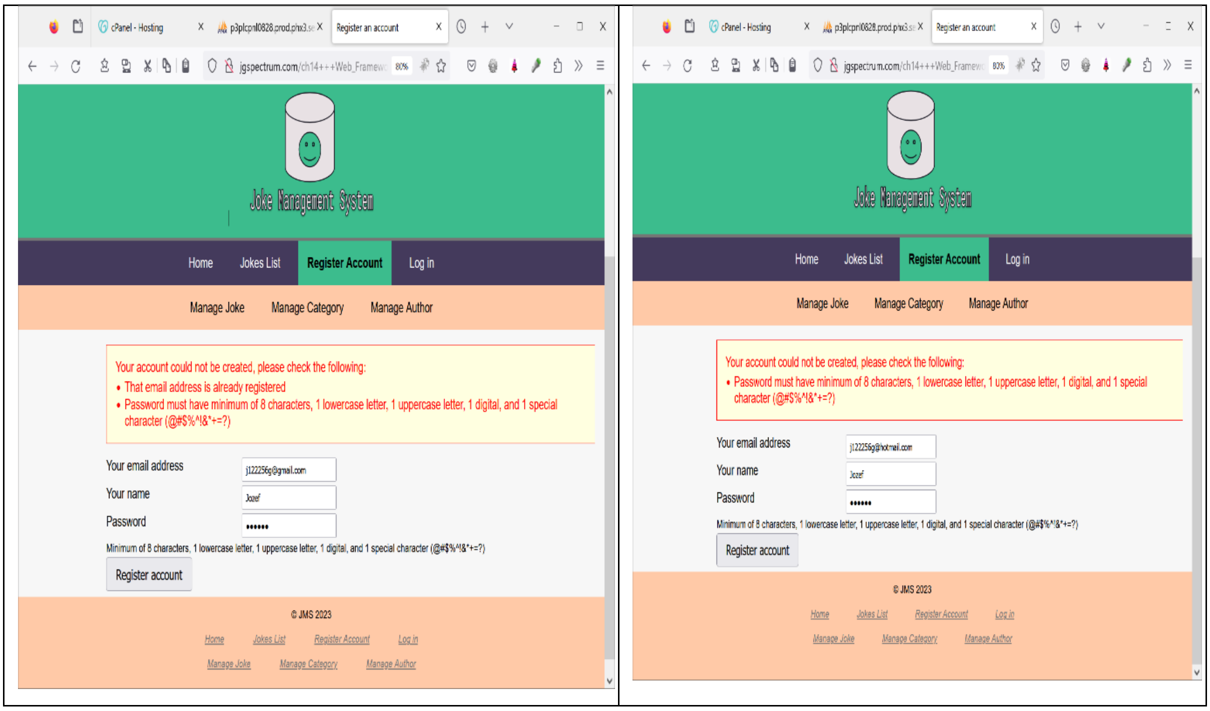
Your email address

Your name

Password

Minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^!&*+=?)

Figure 6. IJD and EJMS - The public component of the Register page



Your account could not be created, please check the following:

- That email address is already registered
- Password must have minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^!&*+=?)

Your email address j122256g@gmail.com

Your name Jozef

Password ••••••

Minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^!&*+=?)

Your account could not be created, please check the following:

- Password must have minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^!&*+=?)

Your email address j122256g@hotmail.com

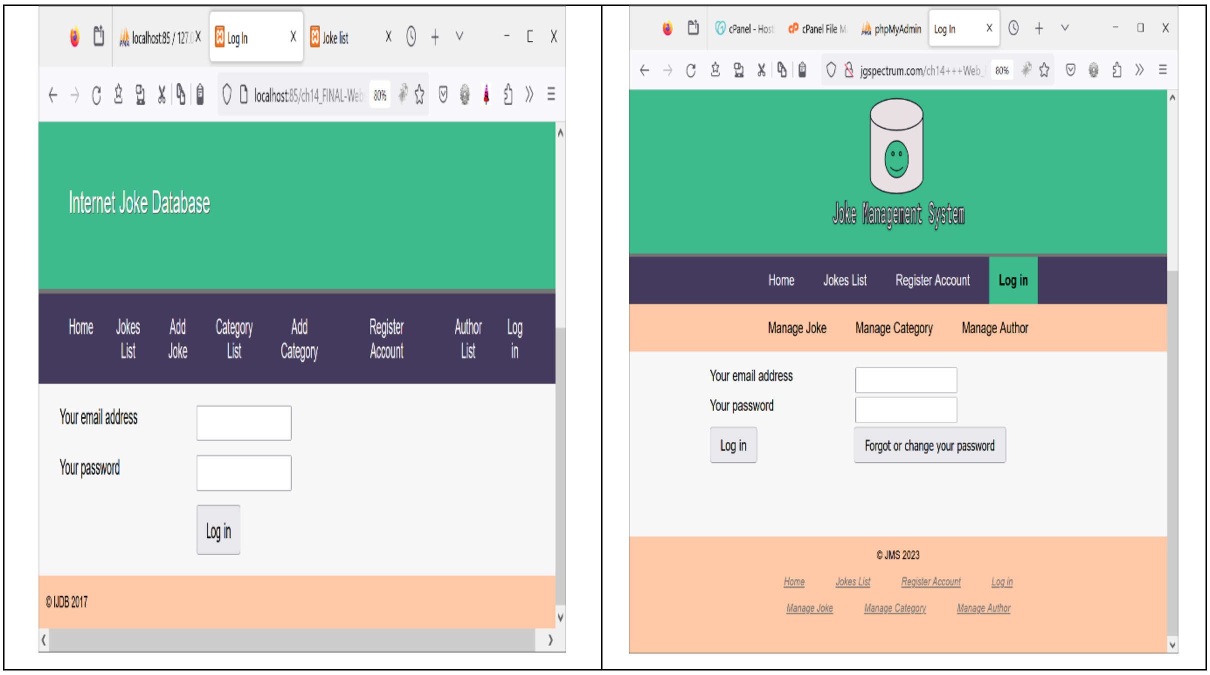
Your name Jozef

Password ••••••

Minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^!&*+=?)

Figure 7. EJMS - The public component of the Register page with errors checking

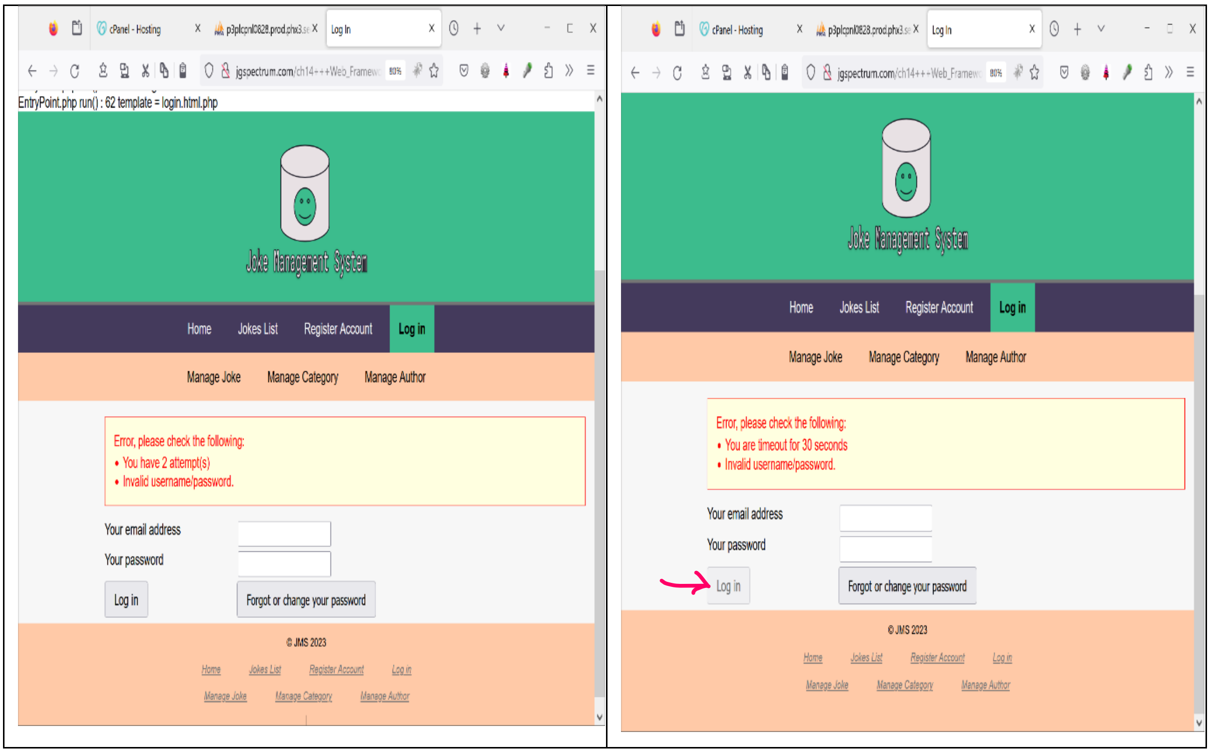
Notice that an error message is displayed for EJMS if the login or password are incorrect (see Figure 9). The user can try to enter the correct values up to three times. After three unsuccessful attempts, the Login button is disabled and the user receives a message to wait 30 seconds before trying again. If the user enters the correct login and password values, a new page will be displayed. The web page will ask the user to enter the OTP (One-Time Password) that was sent to the user's email. The user can also request to resend the OTP if needed (see Figure 10). If the user enters the correct OTP from the email message, a page with the message "Login Successful" and "You are now logged in" will be displayed. Moreover, the main menu item will change from "Log in" to "Log out" and the user's name will appear next to it.



Your email address

Your password

Figure 8. IJD and EJMS - The public component of the Login page



EntryPoint.php run() : 62 template = login.html.php

Error, please check the following:
- You have 2 attempt(s)
- Invalid username/password.

Your email address

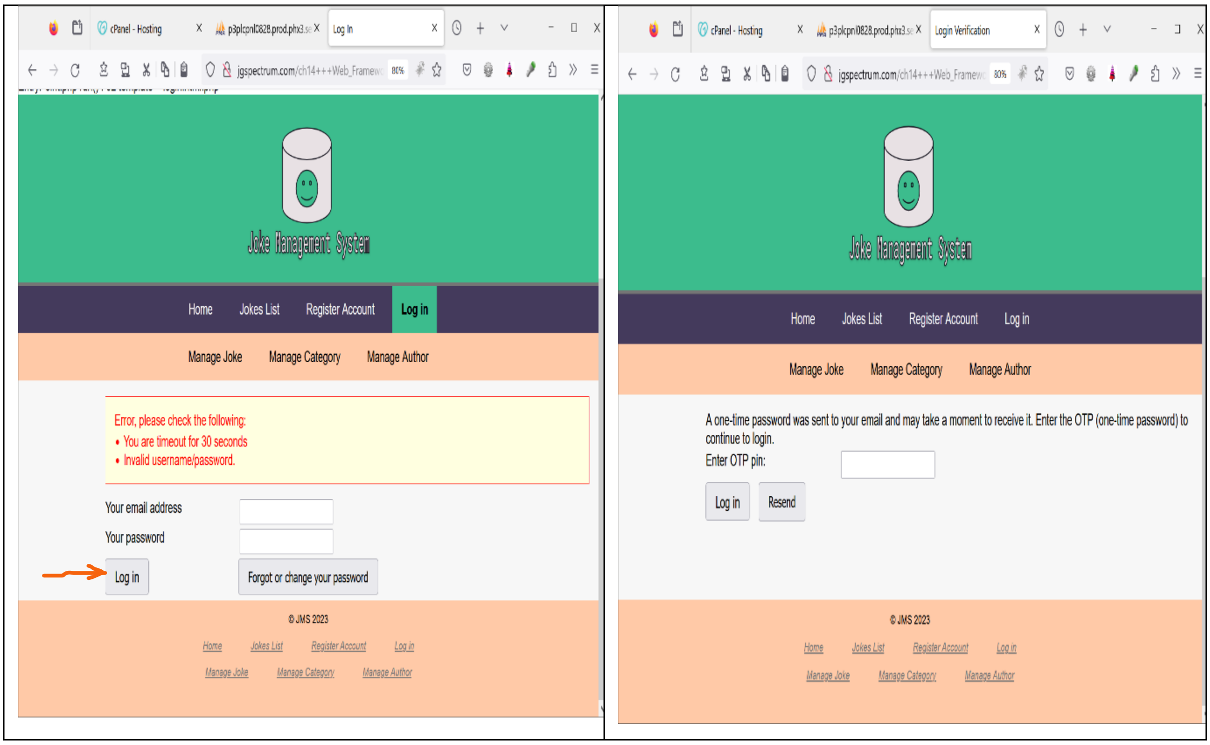
Your password

Error, please check the following:
- You are timeout for 30 seconds
- Invalid username/password.

Your email address

Your password

Figure 9. EJMS: The public component of the Login page with error messages



Error, please check the following:
- You are timeout for 30 seconds
- Invalid username/password.

Your email address

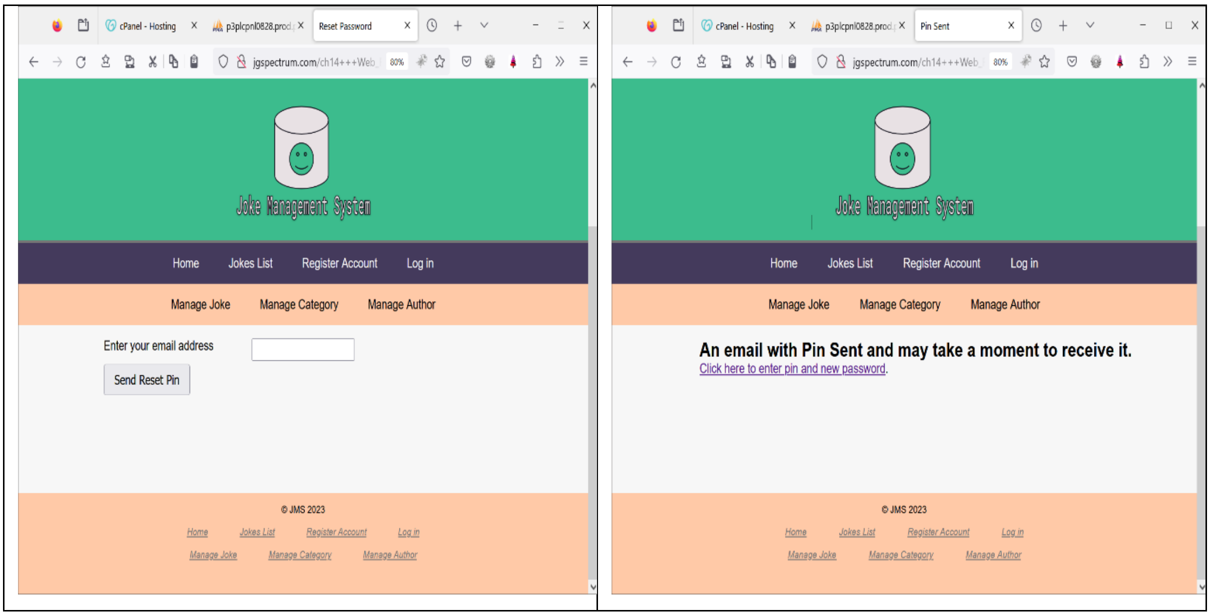
Your password

A one-time password was sent to your email and may take a moment to receive it. Enter the OTP (one-time password) to continue to login.

Enter OTP pin:

Figure 10. EJMS - After 30 seconds the user enters the correct login/password in the Login page

The user can also choose to reset their password by pressing the “Forget or change a password” button shown in Figure 8 – 10. If the user does this, they will be asked to enter their email and press the “Send Reset Pin” button. They will receive a confirmation message saying “An email with Pin has been sent and may take a moment to receive it.” and “Click here to enter pin and new password” (see Figure 11). Figure 12 shows the Login page with a Pin field. The first screenshot shows the error messages that appear if the user enters an incorrect pin or password. The second screenshot shows the successful entry.

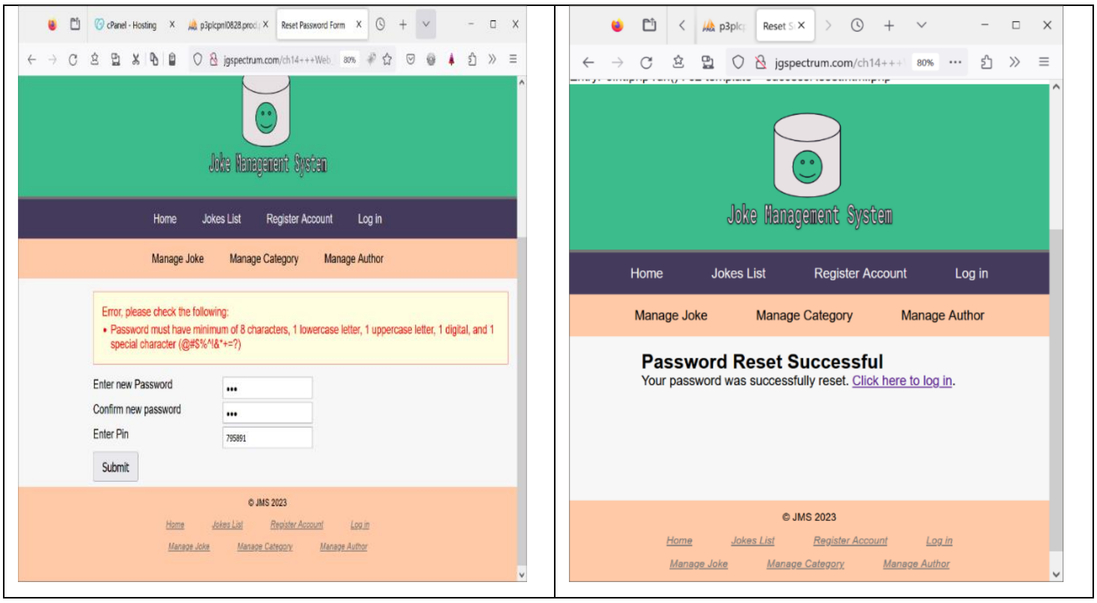


Enter your email address

An email with Pin Sent and may take a moment to receive it.

Click here to enter pin and new password.

Figure 11. EJMS - The public component of the Login page when the user enters the correct login/password after 30 seconds



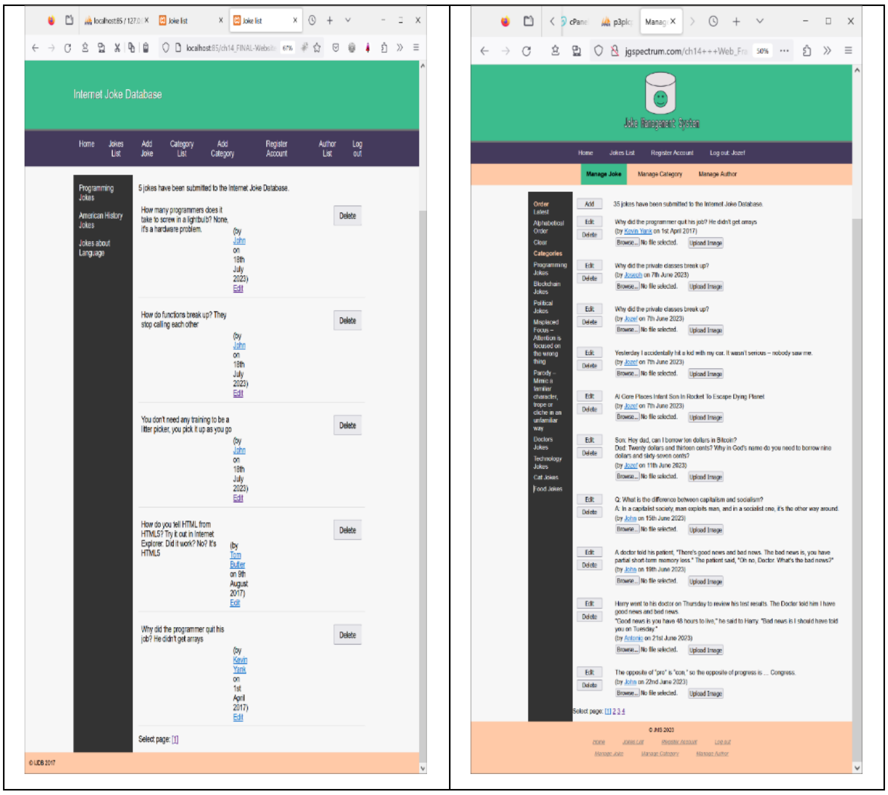
Error, please check the following:
- Password must have minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digital, and 1 special character (@#$%^&*+=?)

Enter new Password •••
Confirm new password •••
Enter Pin 795891

Password Reset Successful
Your password was successfully reset. Click here to log in.

Figure 12. EJMS - Login page with a Pin field. The first screenshot shows error messages and the second one after a successful entry

When the user logs in for the first time, they have the lowest admin permission and can only access the Joke List (for IJD) page and the Manage Joke (for EJMS) page **without** the Edit and Delete buttons. To get full access to all the features, a super admin needs to change the permission for the first-time user using the Author List (for IJD) and Manage Author (for EJMS) pages. Figures 13 - 14 show how the user interface looks like when the user has all the privileges for jokes and categories. The Joke List or Manage Joke pages also have pagination at the bottom to improve performance by reducing the amount of data displayed on a single screen (see Figure 13).



5 jokes have been submitted to the Internet Joke Database.

How many programmers does it take to screw in a lightbulb? None, it's a hardware problem. (by John on 18th July 2023)

How do functions break up? They stop calling each other (by John on 18th July 2023)

You don't need any training to be a litter picker, you pick it up as you go (by John on 18th July 2023)

How do you tell HTML from HTML5? Try it out in Internet Explorer. Did it work? No? It's HTML5 (by Tom Butler on 9th August 2017)

Why did the programmer quit his job? He didn't get arrays (by Kevin Yank on 1st April 2017)

Select page: [1]

35 jokes have been submitted to the Internet Joke Database.

Why did the programmer quit his job? He didn't get arrays
(by Kevin Yank on 1st April 2017)
No file selected.

Why did the private classes break up?
(by Joseph on 7th June 2023)
No file selected.

Why did the private classes break up?
(by Jozef on 7th June 2023)
No file selected.

Yesterday I accidentally hit a kid with my car. It wasn't serious – nobody saw me.
(by Jozef on 7th June 2023)
No file selected.

Al Gore Places Infant Son In Rocket To Escape Dying Planet
(by Jozef on 7th June 2023)
No file selected.

Son: Hey dad, can I borrow ten dollars in Bitcoin?
Dad: Twenty dollars and thirteen cents? Why in God's name do you need to borrow nine dollars and sixty-seven cents?
(by Jozef on 11th June 2023)
No file selected.

Q: What is the difference between capitalism and socialism?
A: In a capitalist society, man exploits man, and in a socialist one, it's the other way around.
(by John on 15th June 2023)
No file selected.

A doctor told his patient, "There's good news and bad news. The bad news is, you have partial short-term memory loss." The patient said, "Oh no, Doctor. What's the bad news?"
(by John on 19th June 2023)
No file selected.

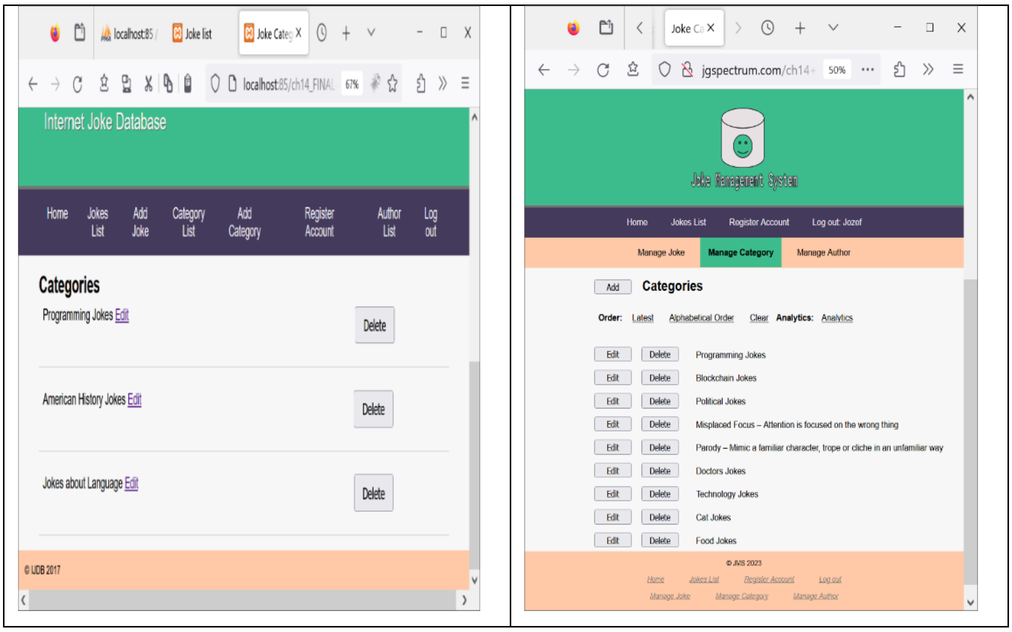
Harry went to his doctor on Thursday to review his test results. The Doctor told him I have good news and bad news.
"Good news is you have 48 hours to live," he said to Harry. "Bad news is I should have told you on Tuesday."
(by Antonio on 21st June 2023)
No file selected.

The opposite of "pro" is "con," so the opposite of progress is ... Congress.
(by John on 22nd June 2023)
No file selected.

Select page: [1] 2 3 4

Figure 13. IJD and EJMS - Joke List and Manage Jokes pages correspondingly after the user is authenticated

Note that the user can choose the order of the categories for the Manage Joke and Category pages in EJMS. The user can either display the newest records at the end or sort them alphabetically (see Figures 13 – 14, feature 16).



Categories

Programming Jokes Edit

American History Jokes Edit

Jokes about Language Edit

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Categories

Programming Jokes
Blockchain Jokes
Political Jokes
Misplaced Focus – Attention is focused on the wrong thing
Parody – Mimic a familiar character, trope or cliche in an unfamiliar way
Doctors Jokes
Technology Jokes
Cat Jokes
Food Jokes

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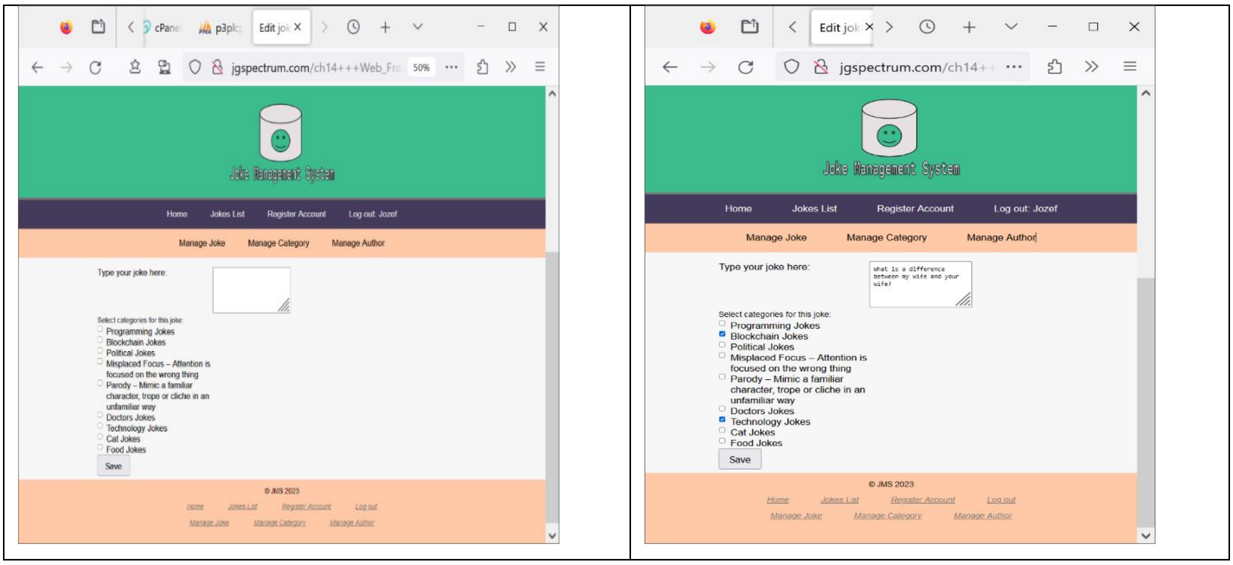
Figure 14. IJD and EJMS - Category List and Manage Category pages correspondingly after the user is authenticated

The Add Joke and Add Category menu items for IJD are replaced by the Add button on the top of each page for EJMS. The user can use this button to add a new joke or category from the Manage Joke and Manage Category pages (see Figures 13 – 14, Features 8 - 9). The Add Joke and Edit Joke pages are the same for both IJD and EJMS (see Figure 15). Similarly, the Add Category and Edit Category pages are the same for both IJD and EJMS (see Figure 16).



Type your joke here:

Select categories for this joke:
□ Programming Jokes
□ Blockchain Jokes
□ Political Jokes
□ Misplaced Focus – Attention is focused on the wrong thing
□ Parody – Mimic a familiar character, trope or cliche in an unfamiliar way
□ Doctors Jokes
□ Technology Jokes
□ Cat Jokes
□ Food Jokes

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Type your joke here: what is a difference between my wife and your wife?

Select categories for this joke:
□ Programming Jokes
☑ Blockchain Jokes
□ Political Jokes
□ Misplaced Focus – Attention is focused on the wrong thing
□ Parody – Mimic a familiar character, trope or cliche in an unfamiliar way
□ Doctors Jokes
☑ Technology Jokes
□ Cat Jokes
□ Food Jokes

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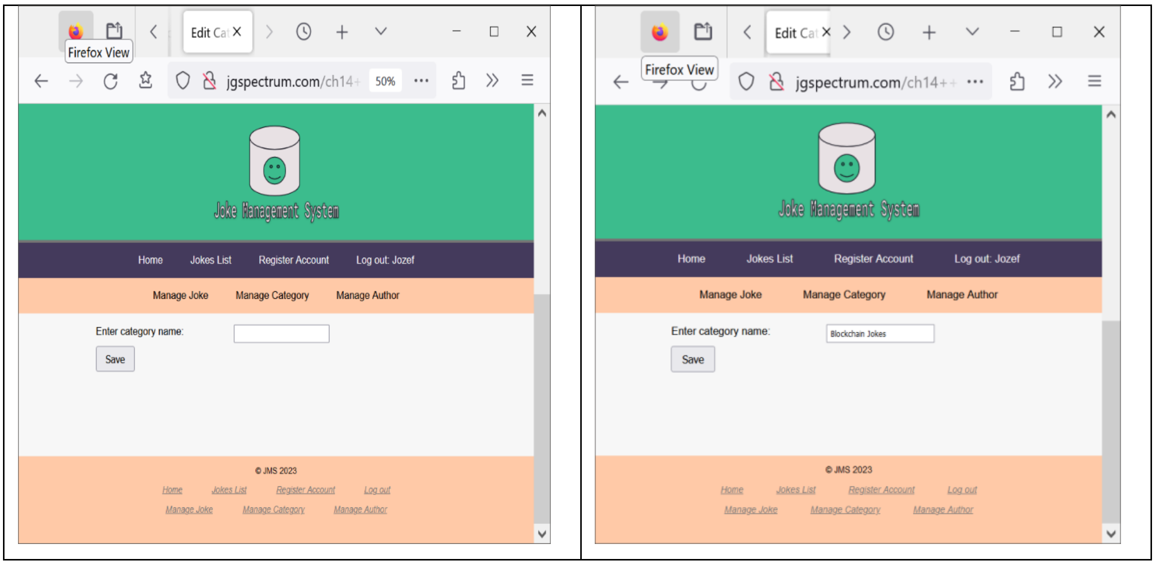
Figure 15. Add Joke and Edit Joke pages are the same for IJD and EJMS

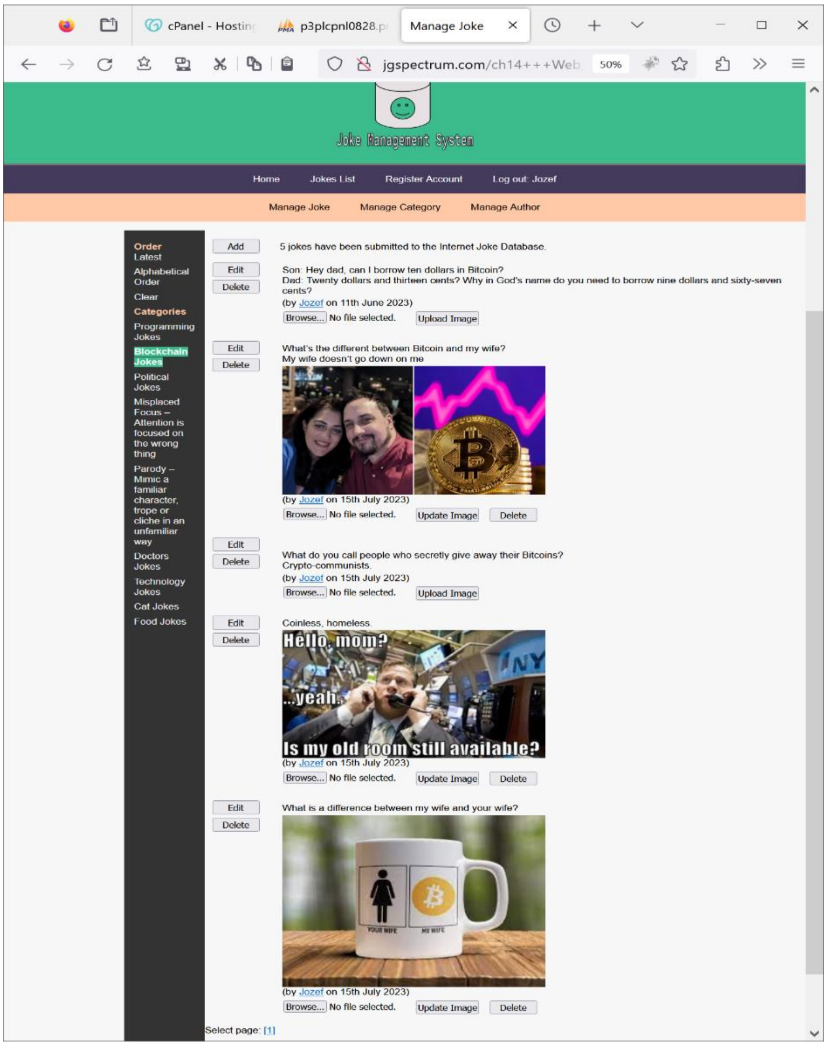
A new feature 7 has been introduced regarding binary files. Logged-in users can upload, update, and delete images. Figure 17 shows that Blockchain Jokes are selected by highlighting the menu item, and all images have the option to Browse, Update Image, and Delete buttons.



Enter category name:

Enter category name: Blockchain Jokes

Figure 16. Add Category and Edit Category pages are the same for IJD and EJMS



5 jokes have been submitted to the Internet Joke Database.

Son: Hey dad, can I borrow ten dollars in Bitcoin?
Dad: Twenty dollars and thirteen cents? Why in God's name do you need to borrow nine dollars and sixty-seven cents?
(by Jozef on 11th June 2023)
No file selected.

What's the different between Bitcoin and my wife?
My wife doesn't go down on me
(by Jozef on 15th July 2023)
No file selected.

What do you call people who secretly give away their Bitcoins?
Crypto-communists.
(by Jozef on 15th July 2023)
No file selected.

Coinless, homeless.
(by Jozef on 15th July 2023)
No file selected.

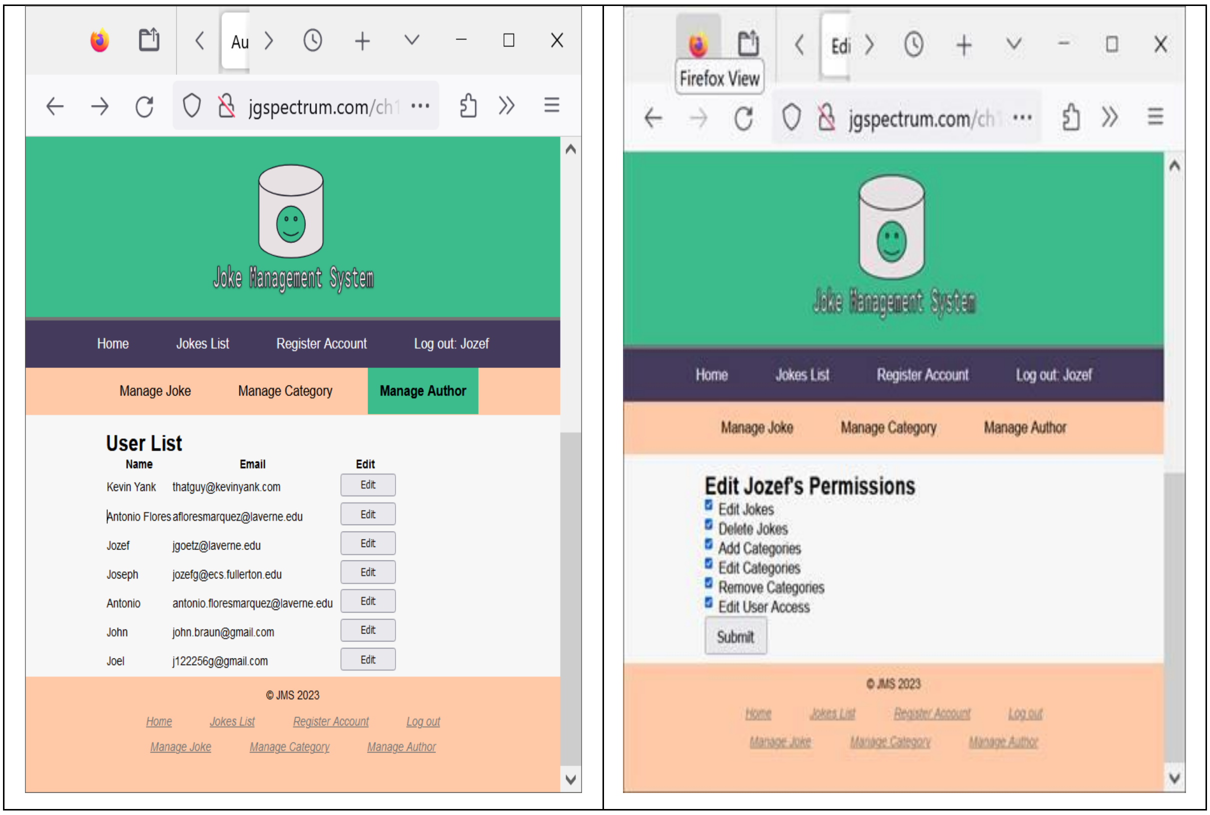
What is a difference between my wife and your wife?
(by Jozef on 15th July 2023)
No file selected.

Select page: [1]

Figure 17. Logged in users can upload, update and delete an image

Users have the ability to upload an image along with their Manage Joke pages. If the joke already has an image, a Delete button is displayed to allow the user to delete the image. Also, the Browse and Upload image buttons continue to be displayed to allow the user to replace the image file. The image file will not be uploaded to the database if it is larger than 16000 KB or if the image file is not a .jpeg, .jpg, or .png. Users are only able to upload an image file if the joke belongs to them and if they have admin permissions to edit other users' jokes.

The admin users who have access to Author List (for IJD) or Manage Author (for EJMS) can edit permissions for themselves or others (refer to Figure 18).



User List

Name	Email	Edit
Kevin Yank	thatguy@kevinyank.com	Edit
Antonio Flores	afloresmarquez@laverne.edu	Edit
Jozef	jgoetz@laverne.edu	Edit
Joseph	jozefg@ecs.fullerton.edu	Edit
Antonio	antonio.floresmarquez@laverne.edu	Edit
John	john.braun@gmail.com	Edit
Joel	j122256g@gmail.com	Edit

Edit Jozef's Permissions

☑ Edit Jokes
☑ Delete Jokes
☑ Add Categories
☑ Edit Categories
☑ Remove Categories
☑ Edit User Access

Submit

Figure 18. Manage User page. The second one is available to grant permission after clicking the Edit button

Business Logical Layer

The Business Logical Layer (BLL) consists of PHP generic and project-specific classes where data is processed. A specific PHP connection class facilitates communication with the Data Access Layer (DAL). The BLL hides the SQL statement calls from the UI Layer (see Figure 1). The low-code framework provides methods in PHP generic classes to get and send SQL commands to the database. The application also uses GET, POST, and PUT requests via a PHP routing system to access numerous elements.

A user that is logged into the website can have multiple permissions given to them. The permissions system allows the admin of the site to grant only the necessary permissions to the users (see Figure 18). The following are permissions that are currently available to be assigned to any user.

- *Edit Jokes* – Allows users to edit recipients' information.

- *Delete Jokes* – Allows users to delete recipients from the database.
- *Add Categories* – Allows users to add categories.
- *Edit Categories* – Allow users to edit categories.
- *Remove Categories* – Allow users to remove categories.
- *Edit Author Permissions* – Allows authors to edit other author permissions.

Data Access Layer and Database

The low-code framework (LCF) uses MySQL as a relational database management system (RDBMS). The database is normalized to improve performance and disk space utilization. The UI objects use the Business Logical Layer (BLL) to communicate with the Data Access Layer (DAL). The DAL connects to the RDBMS and requests the content that belongs on the web page. The RDBMS responds by sending the requested content to the DAL. The DAL stores the content into one or more PHP variables of Business Logical Layer (BLL). The UI layer outputs the content in the browser as part of the web page using HTML and CSS code.

The database consists of tables with primary and foreign keys. The business logic is determined by the primary and foreign keys of the tables and the admin permission. Adding, editing, and deleting table records are limited by the business logic. The database structure is designed around the joke and author model. The Application Data Table (see Table 1) stores user-specific information about categories, jokes, and authors. Additionally, two tables, password_reset_temp and verification_codes, store information regarding a new feature 5 - a two-level authentication security subsystem with a temporary password (token) sent to the user’s email address. The last column of Table 1 shows admin menu items in relation to the database table names in the first column.

Table 1. Application Data Tables

(Primary Keys are in bold, Foreign Keys are in italics)

Internet Joke Database (IJD) tables	Internet Joke Database (IJD) table columns	Expanded Joke Management System (EJMS) tables	Expanded Joke Management System (EJMS) table columns	Description	Related Manage Menu Item
category	**id**, name	category	**id**, name	Store category names.	Manage Category
joke_category	*jokeId*, *categoryId*	joke_category	*jokeId*, *categoryId*	Links jokes with categories	
joke	**id**, joketext, jokedate, *authorId*	joke	**id**, joketext, jokedate, *authorId*, filename,	Stores information of jokes.	Manage Jokes

Internet Joke Database (IJD) tables	Internet Joke Database (IJD) table columns	Expanded Joke Management System (EJMS) tables	Expanded Joke Management System (EJMS) table columns	Description	Related Manage Menu Item
			mimetype, filedata		
		password_reset_temp	**id,** email, pin, expDate, *authorId*	Stores information of password reset requests.	
		verification_codes	**id,** *authorId*, pin, expDate	Stores information of verification codes.	
author	**id**, name, email, password, permission	author	**id**, name, email, password, permission	Stores information of authors.	Manage Authors

The database schema diagram in Figure 19 shows the relationship between tables based on primary and foreign keys. The endpoints of each edge in the diagram represent the primary and foreign keys of the tables. The foreign key is represented by a bullet point.

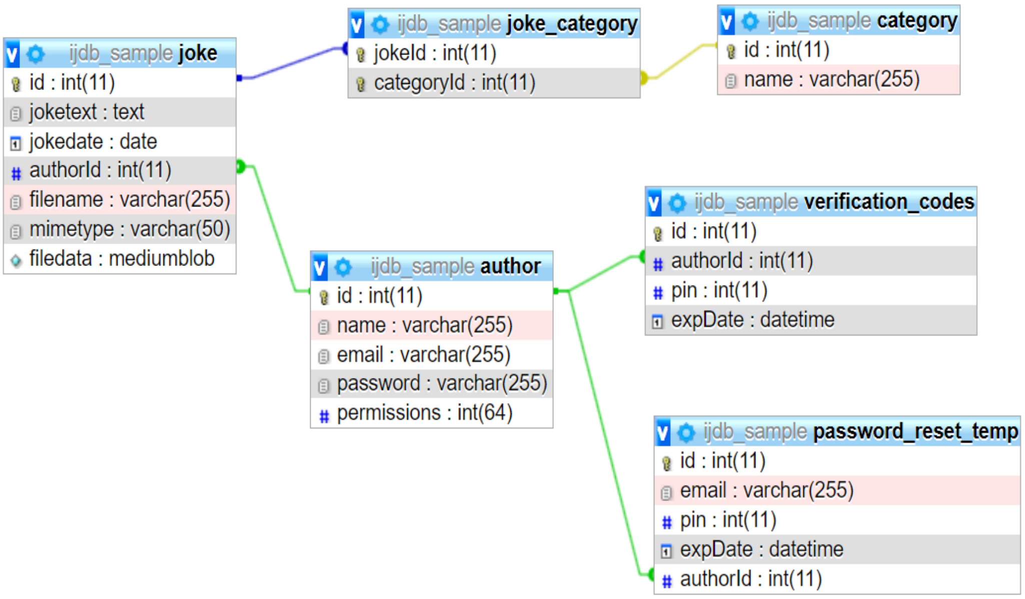
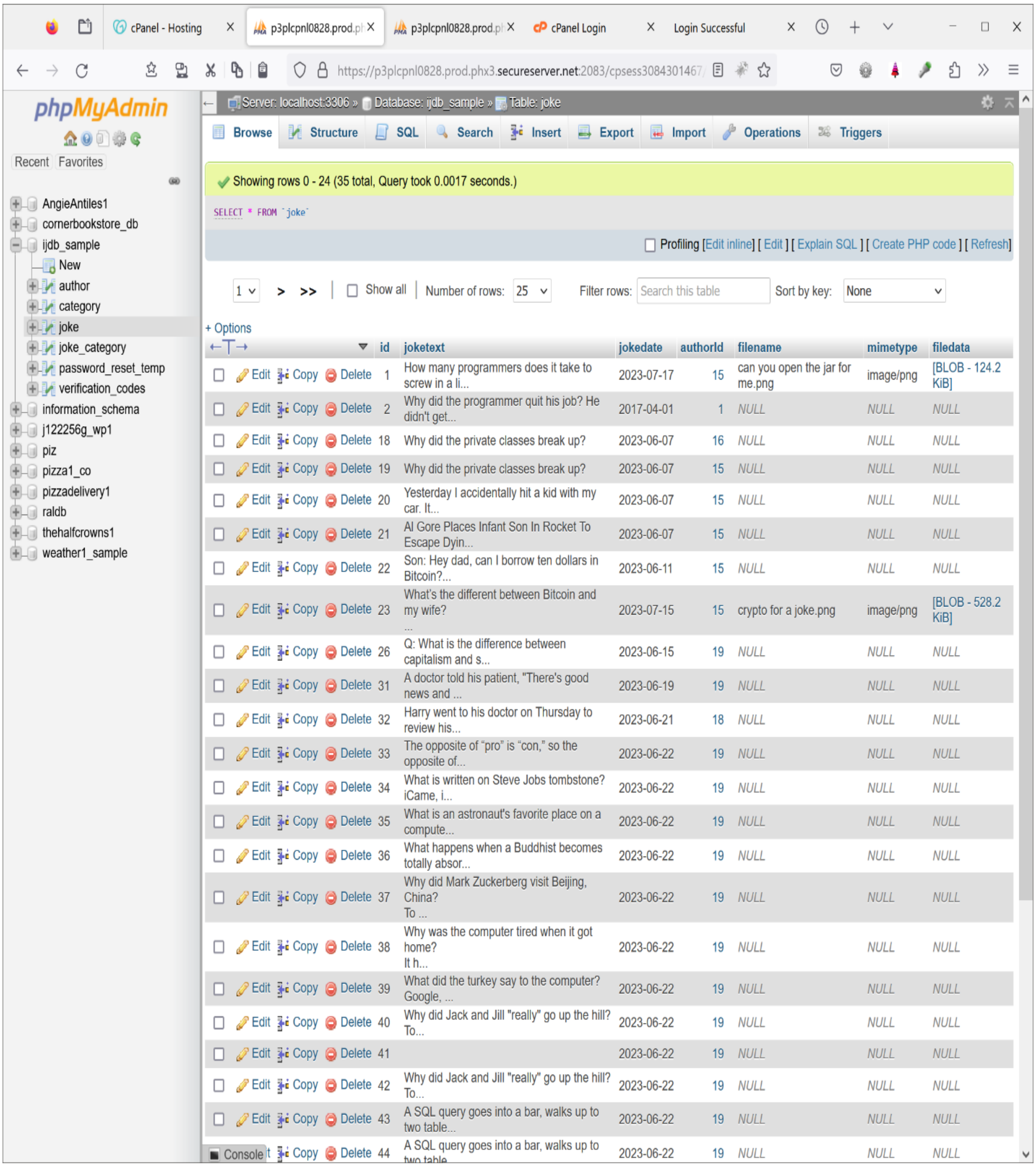


Figure 19. Visual Database Table Relationship

The database schema diagram in Figure 20 shows the implementation of a joke table in phpMyAdmin with many records of jokes.



✓ Showing rows 0 - 24 (35 total, Query took 0.0017 seconds.)

```
SELECT * FROM `joke`
```

□ Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

1 > >> □ Show all | Number of rows: 25 Filter rows: Search this table Sort by key: None

+ Options

	id	joketext	jokedate	authorId	filename	mimetype	filedata
□ Edit Copy Delete	1	How many programmers does it take to screw in a li...	2023-07-17	15	can you open the jar for me.png	image/png	[BLOB - 124.2 KiB]
□ Edit Copy Delete	2	Why did the programmer quit his job? He didn't get...	2017-04-01	1	NULL	NULL	NULL
□ Edit Copy Delete	18	Why did the private classes break up?	2023-06-07	16	NULL	NULL	NULL
□ Edit Copy Delete	19	Why did the private classes break up?	2023-06-07	15	NULL	NULL	NULL
□ Edit Copy Delete	20	Yesterday I accidentally hit a kid with my car. It...	2023-06-07	15	NULL	NULL	NULL
□ Edit Copy Delete	21	Al Gore Places Infant Son In Rocket To Escape Dyin...	2023-06-07	15	NULL	NULL	NULL
□ Edit Copy Delete	22	Son: Hey dad, can I borrow ten dollars in Bitcoin?...	2023-06-11	15	NULL	NULL	NULL
□ Edit Copy Delete	23	What's the different between Bitcoin and my wife? ...	2023-07-15	15	crypto for a joke.png	image/png	[BLOB - 528.2 KiB]
□ Edit Copy Delete	26	Q: What is the difference between capitalism and s...	2023-06-15	19	NULL	NULL	NULL
□ Edit Copy Delete	31	A doctor told his patient, "There's good news and ...	2023-06-19	19	NULL	NULL	NULL
□ Edit Copy Delete	32	Harry went to his doctor on Thursday to review his...	2023-06-21	18	NULL	NULL	NULL
□ Edit Copy Delete	33	The opposite of “pro” is “con,” so the opposite of...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	34	What is written on Steve Jobs tombstone? iCame, i...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	35	What is an astronaut's favorite place on a compute...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	36	What happens when a Buddhist becomes totally absor...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	37	Why did Mark Zuckerberg visit Beijing, China? To ...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	38	Why was the computer tired when it got home? It h...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	39	What did the turkey say to the computer? Google, ...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	40	Why did Jack and Jill "really" go up the hill? To...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	41		2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	42	Why did Jack and Jill "really" go up the hill? To...	2023-06-22	19	NULL	NULL	NULL
□ Edit Copy Delete	43	A SQL query goes into a bar, walks up to two table...	2023-06-22	19	NULL	NULL	NULL
t Copy Delete	44	A SQL query goes into a bar, walks up to two table	2023-06-22	19	NULL	NULL	NULL

Figure 20. Expanded Joke Management database table with data examples

Implementation

Figure 21 shows the relationship between project files and the website map. New files added to the Expanded Joke Management System are in bold, and modified files are in italic.

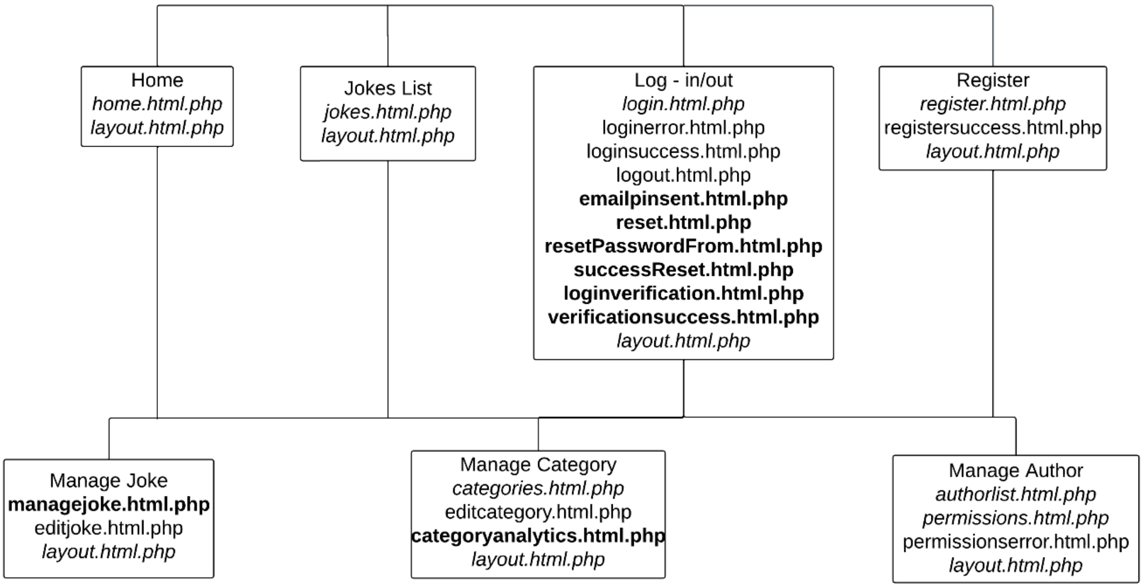


Figure 21. Website map with corresponding file names

Test and Results

Testing the website is a crucial step in the project. For instance, testing the login subsystem (refer to Figures 8-12) or register subsystem (refer to Figure 7) would be an example of a test case. The register subsystem expects four inputs: a name, an email address in the correct format, and password. The software must check whether the email, name, and password are in the correct format.

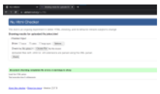
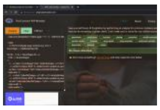
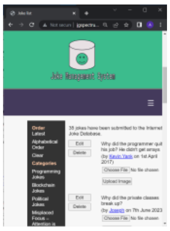
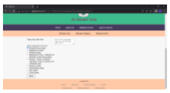
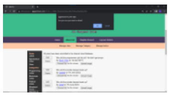
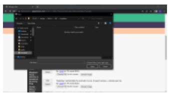
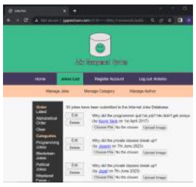
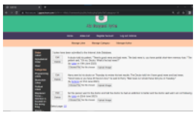
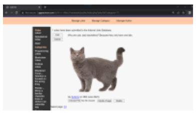
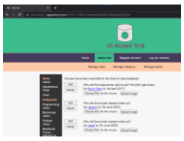
Password security requires that a password should have a minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digit, and 1 special character. If any of these checks are not true, the software doesn't allow the user to register and doesn't let incomplete data be sent to the database. An example use case for the login or register system is that the user can visit the register or login page and fill out the form to register or log in to the app. If the entered data is correct i.e., satisfies the requirements, then the data is sent to the database and the user can log in.

Testing for the website is performed on all web pages. Responsive design principles (feature 1) are implemented for mobile phones, tablets, and desktops (see Table 2, the last three columns). The example of a verification matrix for the Manage Joke of Expanded Joke Management System is shown in Table 2.

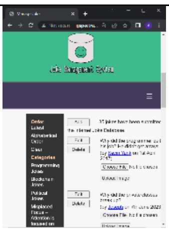
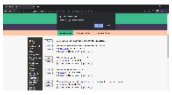
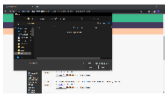
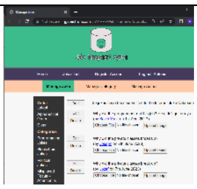
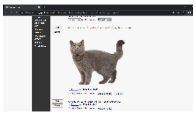
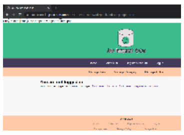
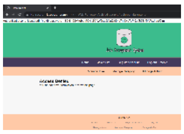
All links are tested, and they work. Test cases for possible inputs are performed for any input fields on the site. HTML, CSS [Felke-Morris, T. (2021), and PHP [Butler, T., & Yank, K. (2017)] errors are tested using validation services [W3C Markup Validation Service (2023**)**, W3C CSS Validation Service (2023), **PHP** Code Checker (2023)]. Testing ensures that no improper data is entered into the database.

Table 2. Test plan and results - Verification Matrix for the Manage Joke of Expanded Joke Management System

1. Page name - list all pages in the menu order	2. Test item- list hyperlinks, fields, buttons, videos, images, GUI controls, web pages. Schema: click action => reaction Legend: => means land in	3. Validation each web page using http://validator.w3.org and http://jigsaw.w3.org/css-validator/ - if applicable;	4. Outcome in Mobile Phone. Resolution 320x480	5. Outcome in tablet. Resolution 1024x768	6. Outcome in desktop. Resolution 1440*900.

joke.html.php	Home=>home.html.php;
	Jokes List => joke.html.php;
	Register => Register an account;
	Log in => log in user;
	
	LOGGED IN:
	Manage Author => authorlist.html.php;
	Manage Joke => managejoke.html.php;
	Manage Categories => categories.html.php;
	Log out => log out user;
	Edit Button => editrecipient.html.php;
	Delete Button => delete function;
	Upload Button => Upload Image;
	Choose File => Allows user to choose file.
		Correct using http~~:/~~/validator.w3.org: 
		Validate PHP code using: http://phpcodechecker.com/: 
			- Good display in chrome. 
			Test Edit Button: 
			Test Delete Button: 
			Test Choose file button: 
				- Good display in chrome. 
				Test Filter: 
				Test Upload/Update button: 
					- Good display in chrome. 

managejoke.html.php	Home=>home.html.php; Jokes List =>	Correct using http://validat	- Good display in chrome.	- Good display in chrome.	- Good display in chrome.

	joke.html.php;
	Register => Register an account;
	Log in => log in user;
	
	LOGGED IN:
	Manage Author => authorlist.html.php;
	Manage Joke => managejoke.html.php;
	Manage Categories => categories.html.php;
	Log out => log user,
	Add Button => editrecipient.html.php;
	Edit Button => editrecipient.html.php;
	Delete Button => delete function;
	Upload Button => Upload Image;
	Choose File => Allows user to choose file.
		or.w3.org:
		
		Validate PHP code using: http://phpcodechecker.com/:
		
			
			Test Edit Button:
			
			Test Delete Button:
			
			Test Choose file button:
			
				
				Test Add Button:
				
				Test Filter:
				
				Test Upload/Update button:
				
					
					User is not logged in:
					
					User does not have access:
					

Discussion

This project has been a great exercise to show how expandable the low code interactive framework is. The organization and hosting of a website that is capable of reading and writing user inputs from a database is a feature that many modern-day websites have. Many new additions (see features 1 – 16) to the various PHP, CSS, and HTML files were needed to achieve full functionality of the Expanded Joke Management System (EJMS). One of the additions is creating Manage Jokes, Manage Categories, and Manage Authors (features 8 – 9). Another addition is implementing a secondary level of navigation that only displays if the user is logged in (feature 10). Another example of an addition is introducing extended password security (minimum of 8 characters, 1 lowercase letter, 1 uppercase letter, 1 digit, 1 special character). A new addition feature is introduced regarding binary files (feature 7). Logged-in users can upload, update, and delete images associated with a joke text. Software like Notepad++ [Notepad++ (2023)], Visual Studio Code [Visual Studio Code (2023)] and phpMyAdmin which is bundled with XAMPP [XAMPP (2023)] were use as the core software when constructing the web application. The results of the project show that a web application for keeping track of jokes, categories and authors is necessary to make the process of tracking and sharing information more efficient than using an Excel spreadsheet.

Limitations and Future Expansion

Expanded Joke Management System (EJMS) is still limited in features. The current version allows privileged users to perform create, read, write, and delete operations on the connected MySQL database. One limitation in the current version of the website is that changes in permissions are not notified to users whose permissions have been changed. Another limitation is the absence of statistics about the frequency of posted jokes per day, month, and year for all categories and the number of each joke in each category, as well as the average, standard deviation, and variance for entities above.

To solve these limitations, there will have to be a future expansion to the current version of Expanded Joke Management System (EJMS). A future extension will include missing statistics above and introducing web analytical metrics. One future enhancement will be introducing a filter system where users can enter the names of authors to filter results. Another search functionality for entities such as jokes should be implemented for any attributes that entity may have. The database should also be expanded to build a notification system around the authors.

Conclusion

The goal of this work is achieved within the computer science senior project by studying, learning, and expanding the interactive, secure framework for the purpose of designing, implementing, and testing Joke Management System. The main goal of the senior project course (CMPS 499) is to provide a capstone experience in which the student combines knowledge, skills, and topics that the student has already learned with some new topics learned during the course. In addition, students need to have a senior project presentation and write a final project report. All computer science undergraduates are required to take a capstone course senior project at La Verne University and many other universities [Computer Science Curricula (2013)].

Many new additions (see features 1-16) to the various PHP and HTML framework files were successfully added or modified to achieve the well-structured, full functionality of the Expanded Joke Management System (EJMS). The design, implementation, and testing of EJMS with a wide spectrum of general and specific functionalities provide an excellent template for a senior project. Moreover, EJMS is an interactive, responsive, secured password-protected, well-structured, database-driven application. A framework is a set of generic classes that provide flexibility, reusability, scalability, and extensibility.

The current version of EJMS provides an excellent base for further expansion of the general and specific functionality of the framework for any senior project specification that requires keeping track of entities. The web application provides the ability to create, read, update, and delete entries in the connected database built using PhpMyAdmin. The connected database itself and the admin component of EJMS provide a strong foundation for expanding specific functionality of the website for any field.

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