A PROJECT REPORT ON

Algo Visualization

Submitted in partial fulfillment of the requirement for Degree in Bachelor of Engineering (Information Technology)

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Abstract

Searching, sorting and path finding algorithms seem similar to a certain extent to any learner but on a deeper level, they are all different in their own ways. Students very often simply learn the algorithm by rote and don't really understand the depth and working of these algorithms. They don't understand what exactly is happening at every line of code. This often causes confusion for the learner. Our project, however, aims to wipe this confusion out.

The application clears the confusion with the help of algorithm visualisation. As every line of the code of the algorithm is written, accordingly, the output of the code will be depicted in a graphical and tabular form. This helps in clearly understanding what each line of code is actually doing. The graphical and tabular depictions are dynamic. That is, as the code changes, the visualisations will change. The learner can practically try out the working of the algorithms by trying out different values for that particular algorithm and also different conditions (including exceptional conditions). Detailed tutorial explanations and demonstrations will also be provided for the learner. He can also make use of the bookmark feature that helps to refer to his bookmarked notes and resources quickly and efficiently. The learner can also track his progress using the course completion feature. As he learns algorithms, it is recorded and his progress of the course is displayed.

INDEX

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION

1.1 Problem Statement

With the world developing rapidly in various domains of Information Technology, the possibilities of making a career in this domain has become very popular. However, while people rush to make it big in the IT field, many disregard how important it is, that their basics be very clear. It is extremely important that an IT developer is well versed with basic and very essential algorithms. The foundation of software development is hidden in these algorithms. Understanding these basic algorithms paves way for understanding major algorithms. Many times, students learn code by heart without understanding what is happening behind the scenes. They don't clearly understand how the code works and end up having a feeble foundation which is a major setback for any software developer.

1.2 Project Objective

- ❏ To make Sorting, Searching and Path Finding Algorithms exceptionally clear to learners also covering edge cases and exceptions.
- ❏ To visualize basic and advanced algorithms in a pictorial form for better understanding.
- ❏ To provide better documentation of algorithms along with the feature of bookmarks for future reference.
- ❏ To deliver a user friendly educational portal for easy traversal across the application.

1.3 Project Scope

The project provides tutorials of various basic and advanced algorithms varying from Sorting, Searching to Path Finding Algorithms. It also provides pictorial representation of algorithms to enable students to take a deeper dive into fundamental algorithms to strengthen their base. The project is equipped with an exceptional UI and responsive behavior to grant ease while using the application. This also allows learners to bookmark their favorite tutorials for easy access in the future. They can also track their progress as they explore new algorithms and understand them.

1.4 Project Advantages

- **Flexibility**:
  It caters to the needs of inexperienced and experienced learners along with codes provided in top three programming languages making it compatible to a large crowd.

- **User Friendly Portal**
  The application is also equipped with exceptional UI making the traversal across the platform extremely convenient and easy to use. Instructions to use the application are mentioned which makes it user friendly.

- **Responsive Design**
  The application is compatible on all devices ranging from laptops, iPads, tablets to phones.

- **E-learning platform**
  This enables learners to access their learning material and visualizations from all across the world with just net connection.

- **Personalized Access**
  The project allows learners to bookmark their desired algorithms to enable easy access to them later. It also enables them to track their progress and also understand where they stand in terms of gaining knowledge of these algorithms.

1.5 Project Disadvantages

- Learners don't have access to videos explaining the algorithms.
- There are no live sessions or doubt forums for doubt clarifications.
- Comparisons between algorithms are not available at the moment.

Chapter 2

PROJECT PLAN

2.1 Table for Project Plan

Sr. No	Task Name	Duration to Complete	Start Date	End Date	Resource Name
1	Selection of project Topic	3 days	13/7/20	15/7/20	Internet, Group Discussion
2	Requirement Analysis	2 days	20/7/20	21/7/20	Internet,Group discussion
3	Further Research on the selected topic to check feasibility	3 days	24/7/20	26/8/20	Existing similar websites
4	Detailed design of Project database,webpage layouts	3 days	1/8/20	3/8/20	Group Discussion, software utilities,internet
5	Role division	2 days	7/8/20	8/8/20	Group Discussion,
6	Implementation-coding and Rich Environment Design	48 days	4/8/20	28/9/20	Group discussion, Software utilities, Reference book ,internet
7	Testing	2 days	29/9/20	31/9/20	Software utilities
8	Deployment	2 days	3/11/20	5/11/20	Project

2.2 Table for Task Sheet

Sr. No.	Task Name	Sub Task	Start Date	End Date	Person Allotted
1.	Introduction and research on Project related technologies	Understanding and learning HTML,CSS JAVASCRIPT and PHP	13/7/20	20/7/20	Abhishek, Gladina, Ansh
2.	Decisions on design of the project	Finalizing the web Layout and finalizing the database tables.	21/7/20	27/7/20	Abhishek, Gladina, Ansh
3.	Designing the Layout and database	Includes tutorials, homepage,and various other user interactive and responsive web pages	28/7/20	03/8/20	Abhishek, Gladina, Ansh
4.	Coding	Coding various user interface events	04/8/20	7/9/20	Abhishek, Gladina, Ansh
5.	Rich interactive elements added	Designing responsive navigation and cards ,implementation of dynamic web page creation	8/9/20	28/9/20	Abhishek, Gladina, Ansh
6.	Testing and Security	Development of test cases Validation and verification. Includes providing security against SQL injection	29/9/20	5/10/20	Abhishek
7.	Deployment of application on server	Publishing project on server	1/12/20	3/12/20	Abhishek
8.	Documentation	Test plan and Test cases, Final Report Submission	1/11/20	3/12/20	Abhishek, Gladina, Ansh

2.3 Project Roles and Responsibility

Role	Responsibility	Assigned Person
Full Stack Developer	- Path Finding Algorithm Visualization and Tutorials - Authentication Page - Homepage - Course Page	Abhishek Gupta
Full Stack Developer	- Searching Algorithm Visualization and Tutorials - Tutorials Page - Bookmark Page - Course Page	Ansh Chhadva
Full Stack Developer	- Sorting Algorithm Visualization and Tutorials - Tutorials Navigation Page	Gladina Raymond

Chapter 3

REQUIREMENT ANALYSIS

❑ 3.1 Functional Requirements

A software requirements definition is an abstract description of the services which the system should provide and the constraints under which the system must operate. These requirements are offered in the following points:

- ➢ **Login :** We have login for customers who are willing to learn from our high quality tutorials and take notes side by side and download (resources & notes) or store (notes) in our mysql database.

- ➢ **Registration :** For first time users, we provide the functionality of registration with us, so users can take notes side by side while learning new algorithms and keep it private to themselves.

- ➢ **Forgot Password :** For resetting his password, an email will be sent for authentication. Following that, he can change his password.

- ➢ **Retrieval in Tutorials Page** : We retrieve each algorithm tutorial data directly from the mysql database. Tutorial data includes definition, explanation, diagrams, best worst average case complexities of algorithm.

- ➢ **Bookmark :** If a student likes a particular algorithm, he can bookmark it, and it will be visible in the bookmarked system. This helps in easy access of those topics.

- ➢ **Graphic Visualization of Algorithm :** Various Algorithm in Pathfinding , Sorting and Searching algorithm will be visualize in graphical manner in front of user to better understand the algorithm the user can give its own input set and manipulate the

speed of execution of algorithm in real time to enhance the learning experience.

➢ **Performance :** Most of the visualization part is done on the client side which ensures faster performance of the website.

➢ **Reliable :** Our project promises perfect accuracy for each algorithm. This greatly helps the user in deciding the algorithm he wishes to use in his application.

❑ 3.2 Non-Functional Requirements

➢ **Graphical User Interface :** For an interactive use of the website, we provide a navigation bar to the user so that he/she can easily access various website sections at a glance.

➢ **Compatibility :** This website will be available on almost all versions of Chrome ,Mozilla FireFox and Internet Explorer. Also it would be very user friendly and it will be completely responsive so that any person will be able to view on Tablets , Mobile Phones and Desktops of all sizes.

➢ **Authentication :** The login/registration process helps in ensuring that only verified People can login to use all the features including notes and bookmarks .However the student can access the study material and visualization for each algorithm, without logging in.

❑ 3.3 Hardware Requirements

➢ 4 GB RAM
➢ 32 or 64 bit OS
➢ 1 GB ROM
➢ Pentium-V Processor

❑ 3.4 Software Requirements

- ➢ Operating System :- Windows 10
- ➢ Client Side :- HTML5 , CSS3 , Advance Javascript (ES5 - ES8)
- ➢ Server Side :- PHP , MySql
- ➢ Tools used :- Xampp

❑ 3.4 System Features

1. Definition & Animated Video explanation for all algorithms.
2. Algorithm Code Snippets in different languages.
3. Examples for each algorithm.
4. Practical Practice through user input and visualization of each step in animation.
5. Real Time Code and Graphic/Tabular visualization.
6. Algorithm Bookmark features .

Algorithms & their Categories

Path Finding Algo	Searching Algo	Sorting Algo
Dijkstra	Linear	Merge
A star	Binary	Quick
DFS	Exponential	Insertion
BFS	Jump	Selection
Best First Search		Bubble

Fig No: 3.4.1

Chapter 4

DESIGN DOCUMENT

4.1 Design view of web pages layout

- **Login & Register Page**

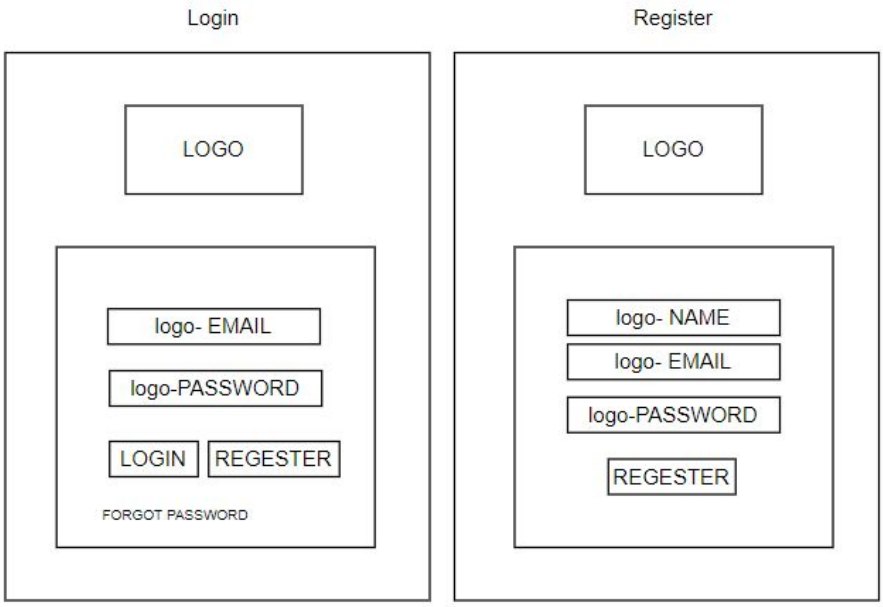


Fig 4.1.1

- **Navigation Bar**

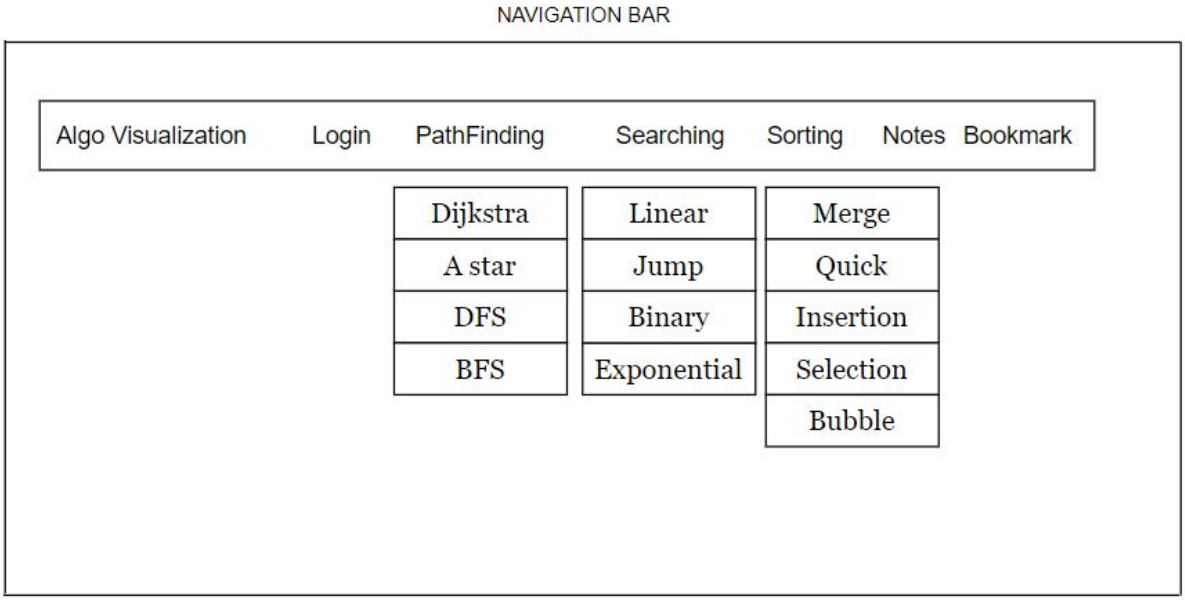


Fig 4.1.2

- **Homepage**

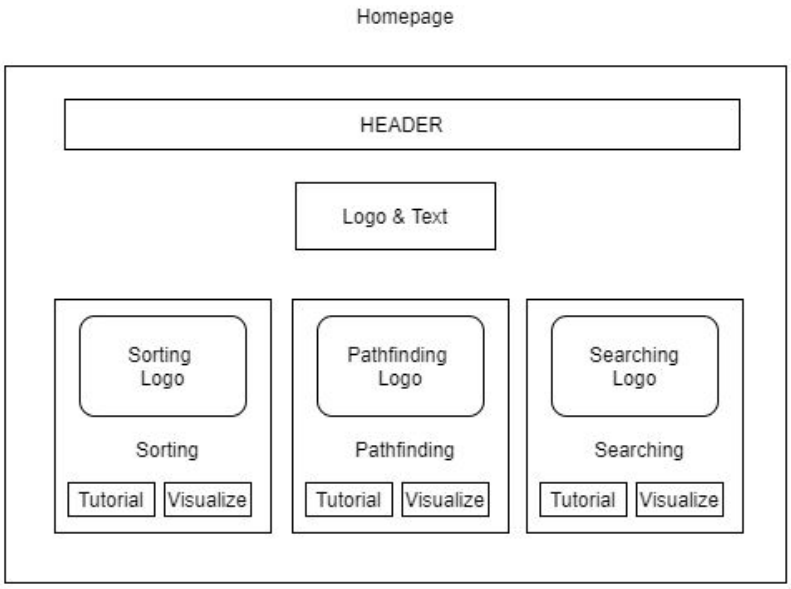


Fig 4.1.3

- **Tutorials-Navigation Page & Bookmark Page**

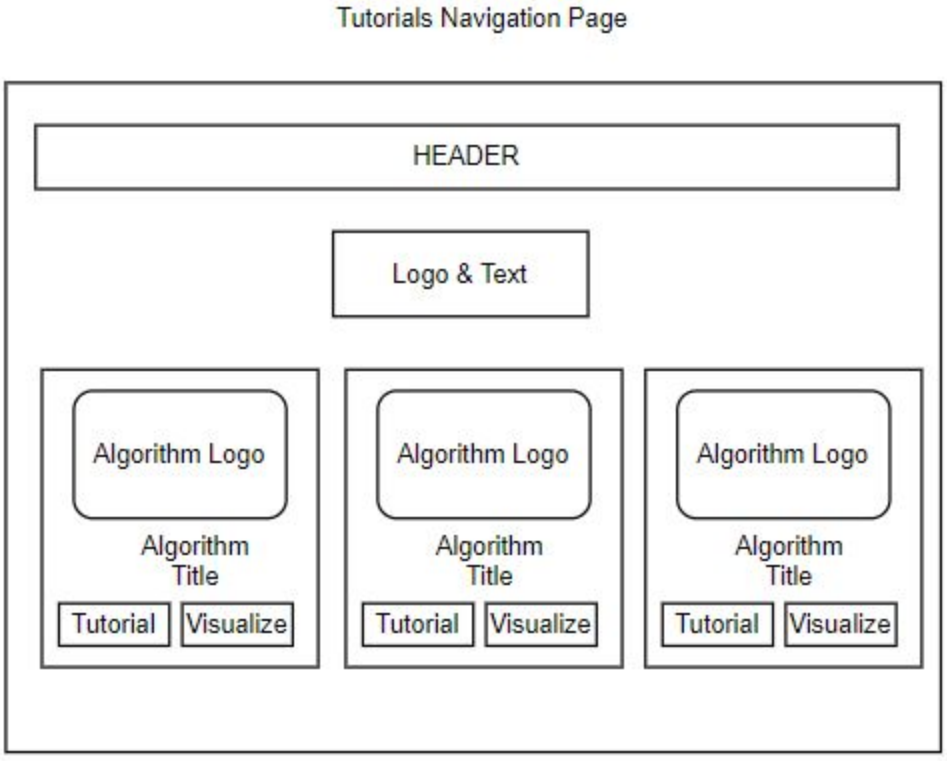


Fig 4.1.4

- **Tutorials Content Page**

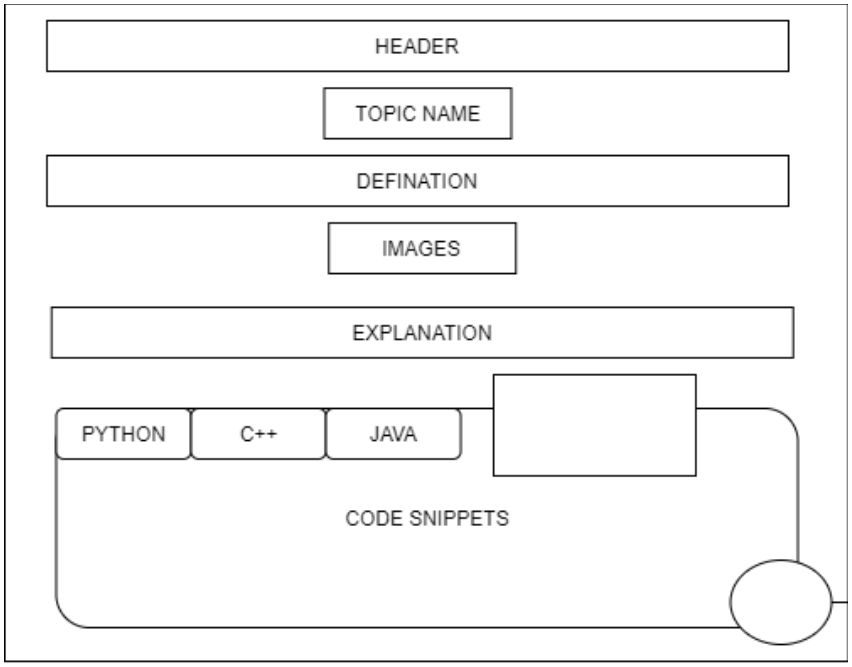


Fig 4.1.5

- **Pathfinding Page**

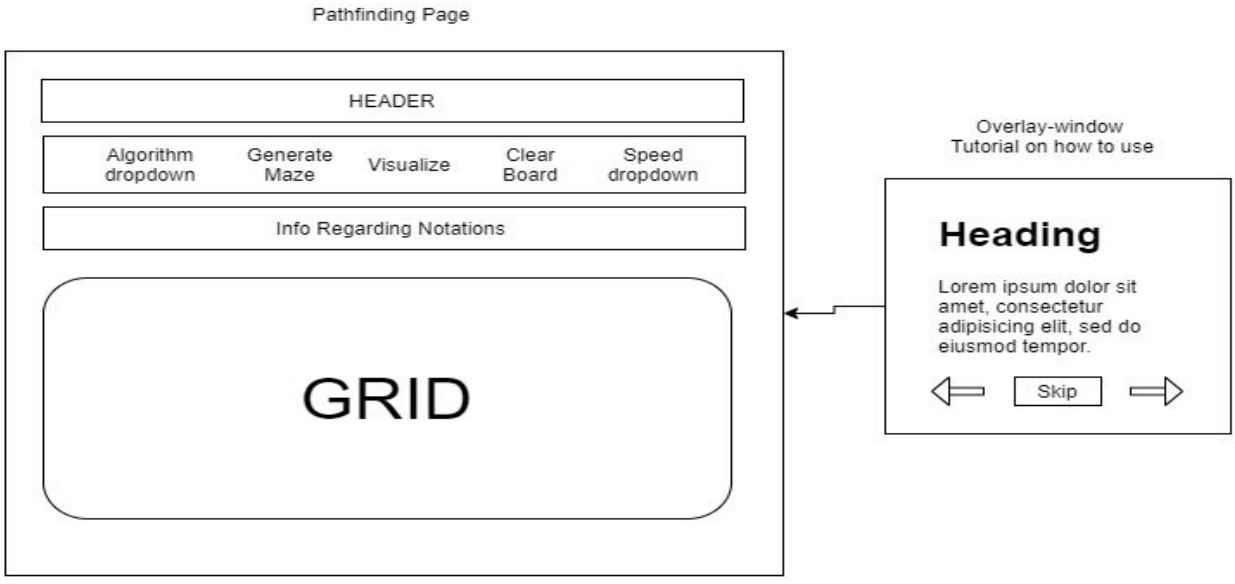


Fig 4.1.6

- **Searching Page**

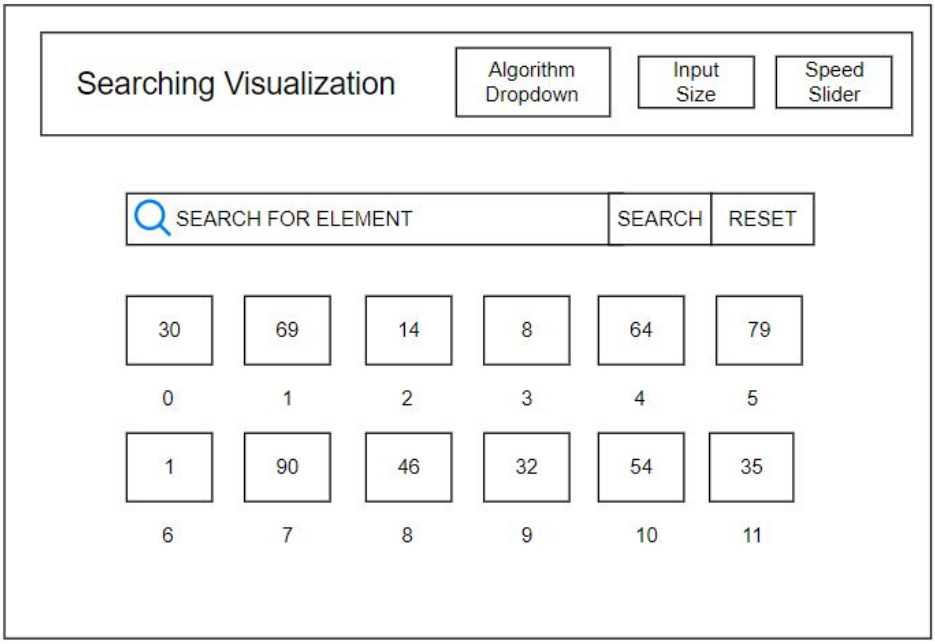


Fig 4.1.7

- **Sorting Page**

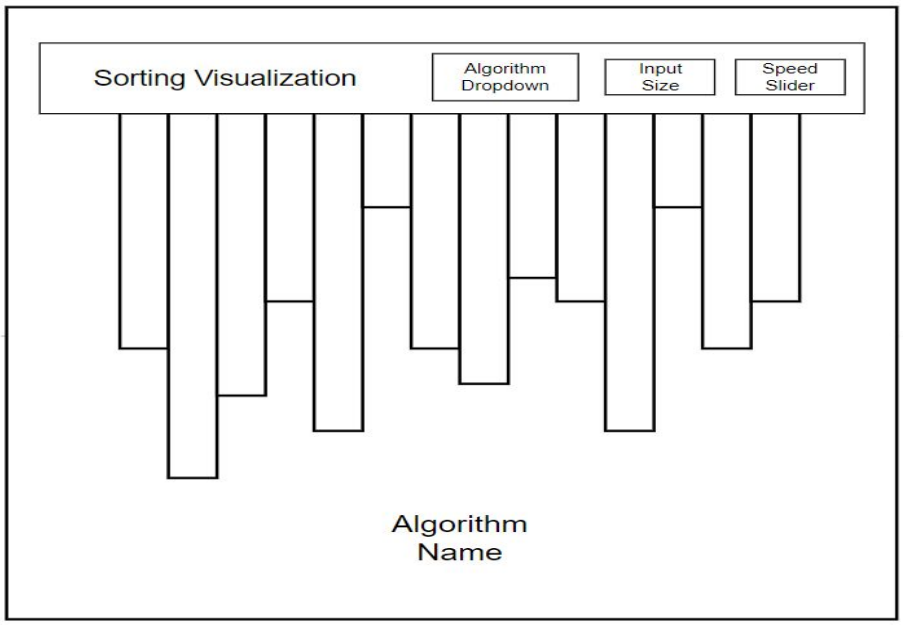


Fig 4.1.8

- **Course Page**

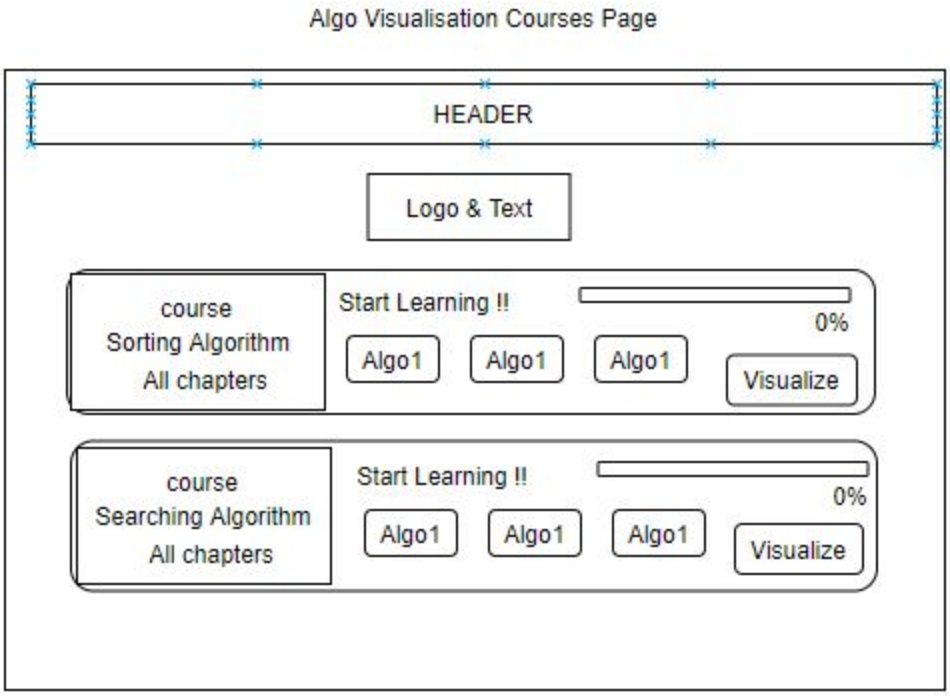


Fig 4.1.9

4.2 RIA design using Ajax

```
<script>
  loadData();

  function loadData() {
    var request = new XMLHttpRequest();
    request.open("GET", "http://localhost/Algo-Visualization/templates/view_bookmark.php", true);
    request.send();
    request.onreadystatechange = function() {
      if (request.readyState == 4 && request.status == 200) {
        console.log(request.responseText);
        document.getElementById("card-decks").innerHTML = request.responseText;
      }
    }
  }
```

```
function deletebookmark(data, user_id) {


  var request = new XMLHttpRequest();
  request.open("GET", "http://localhost/Algo-Visualization/templates/delete_bookmark.php?bm=" + data
  + "&id=" + user_id, true);
  request.send();
  request.onreadystatechange = function() {
    console.log(request.responseText);
  }
  loadData();
}
</script>
```

Chapter 5

DATABASE DESIGN AND CONNECTIVITY

5.1 Database Table Design

user_id	name	email	password

Table 5.1.1 User Authentication Table

algo_id	grp_id	name	definition	image	explanation	pseudo_code	links

Table 5.1.2 AlgorithmTable

bookmark_id	user_id	algo_id

Table 5.1.3 Bookmark Table

course_completion	user_id

Table 5.1.4 Course Table

5.2 Database Connectivity

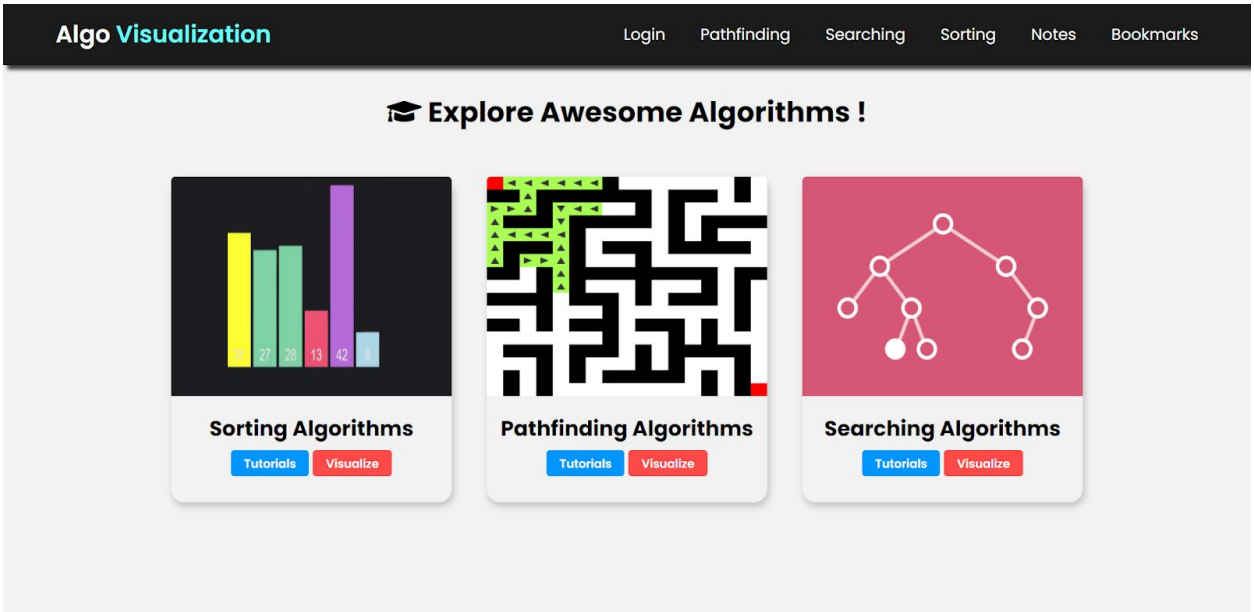
```php
<?php

        $con = mysqli_connect("localhost","root","","algorithms");

        if (mysqli_connect_errno()) {
                echo "Failed to connect to MySql " . mysqli_connect_error();
        }
?>
```

Chapter 6

IMPLEMENTATION DETAILS

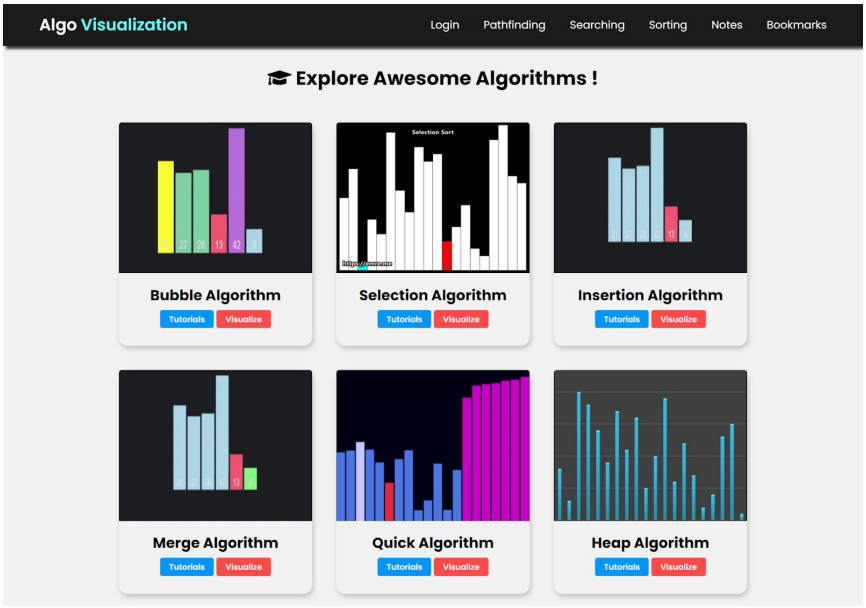
6.1 SNAPSHOTS

HomePage- A responsive homepage containing the 3 main categories of algorithm that is Sorting, Pathfinding and Searching Algorithms along with 2 buttons linking Tutorial Navigation page and Visualization page

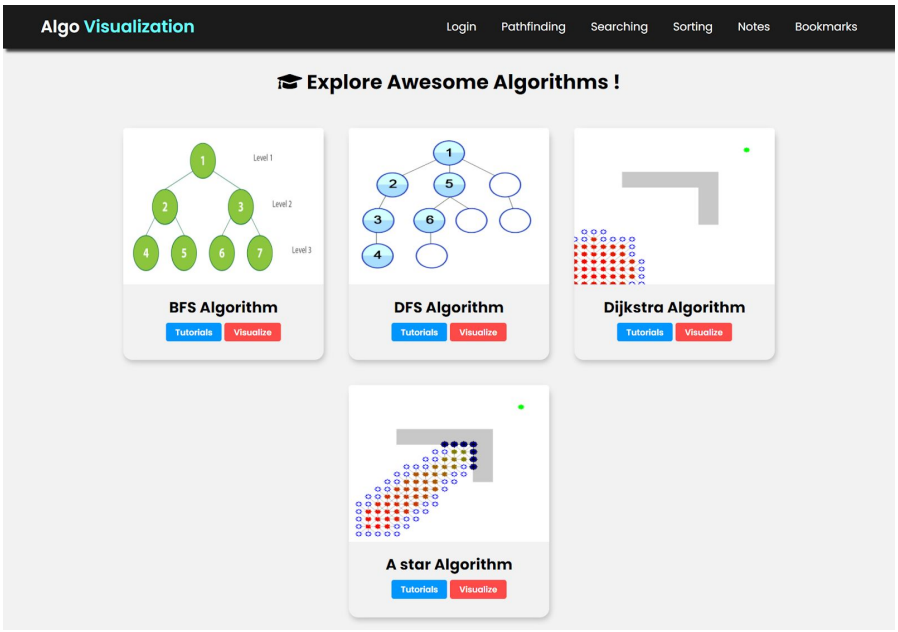


Tutorial Navigation Page- This page consists of each Algorithm which is falling under a particular category

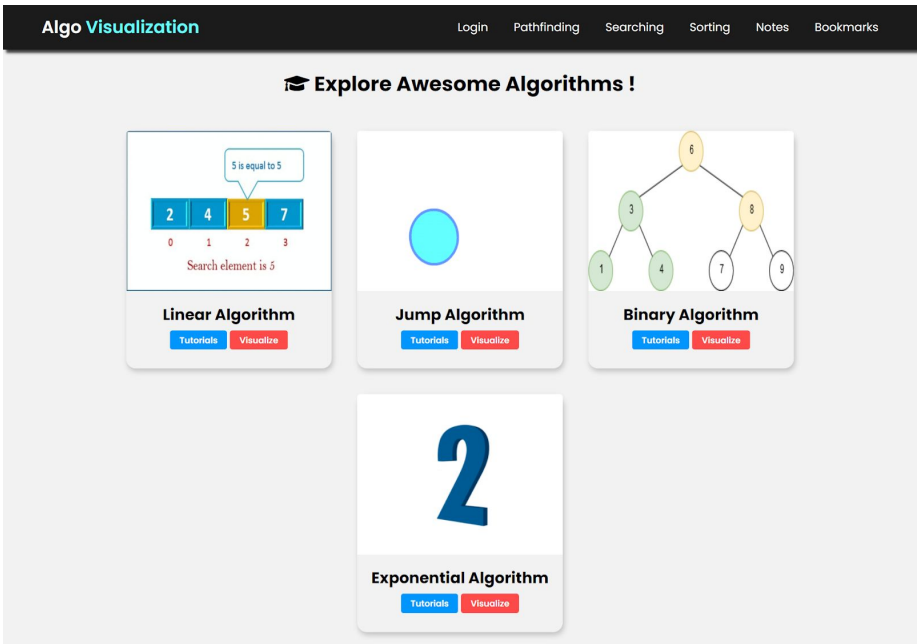
1. **Tutorial Navigation Page for Sorting**



2. Tutorial Navigation Page for Pathfinding

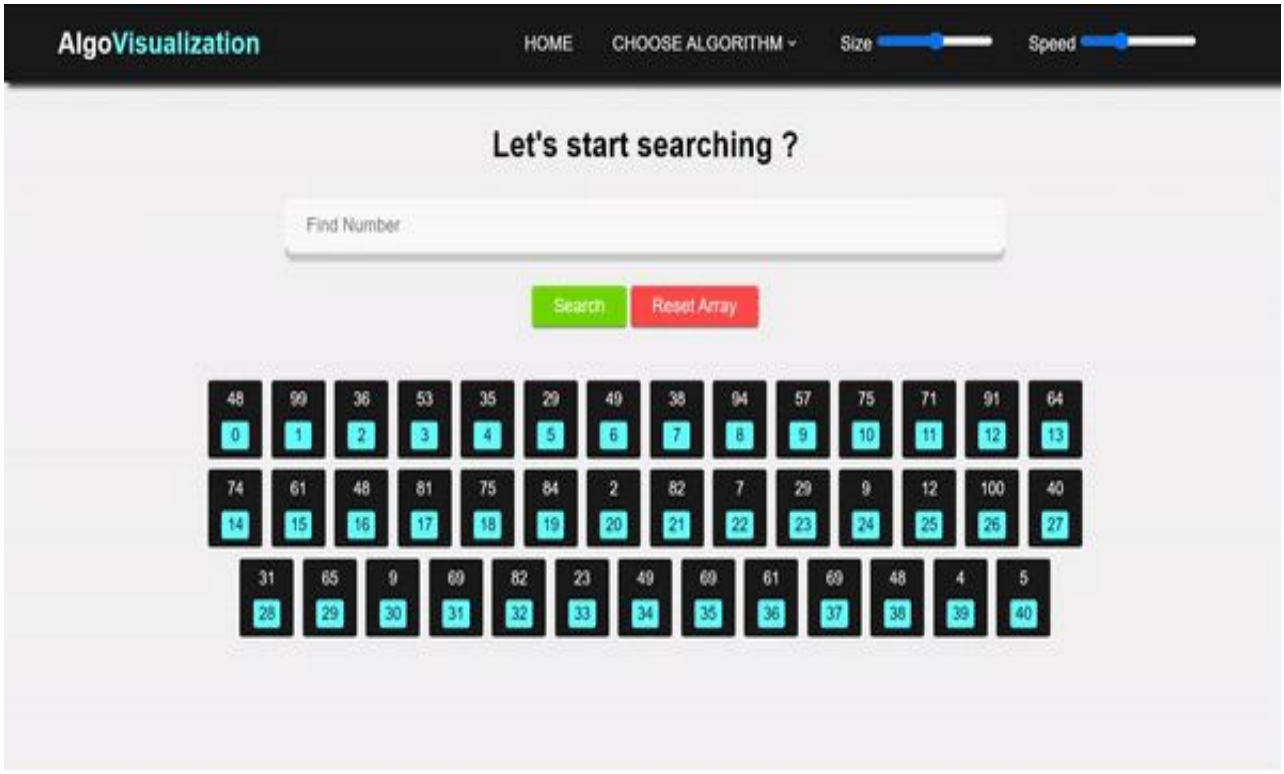


3. Tutorial Navigation Page for Searching

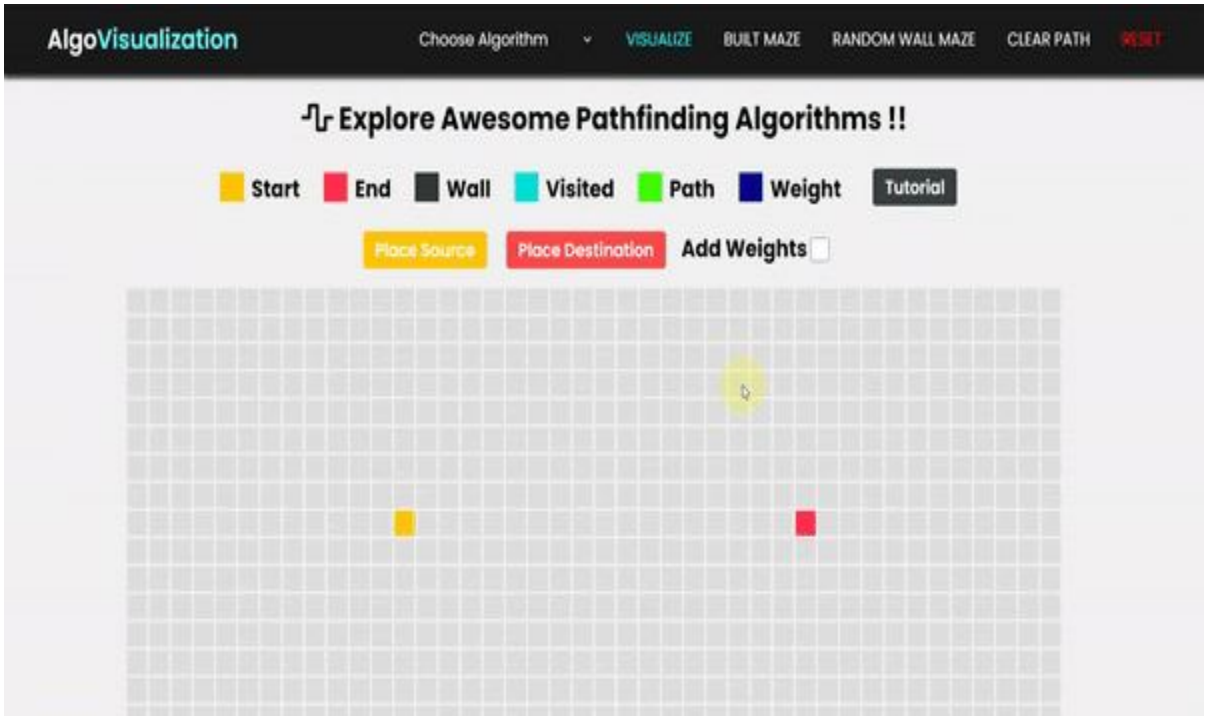


Visualization Page -There are 3 types of Visualization page each belonging to a particular category of Algorithm

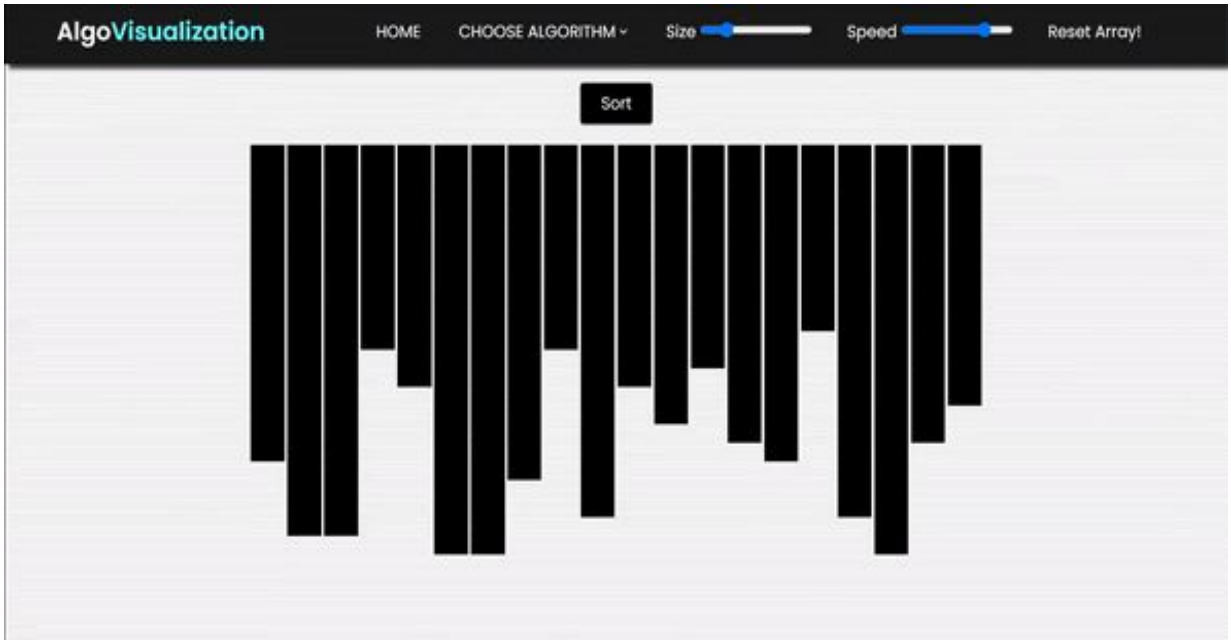
1. Visualization Page for Searching



2. Visualization Page for Pathfinding

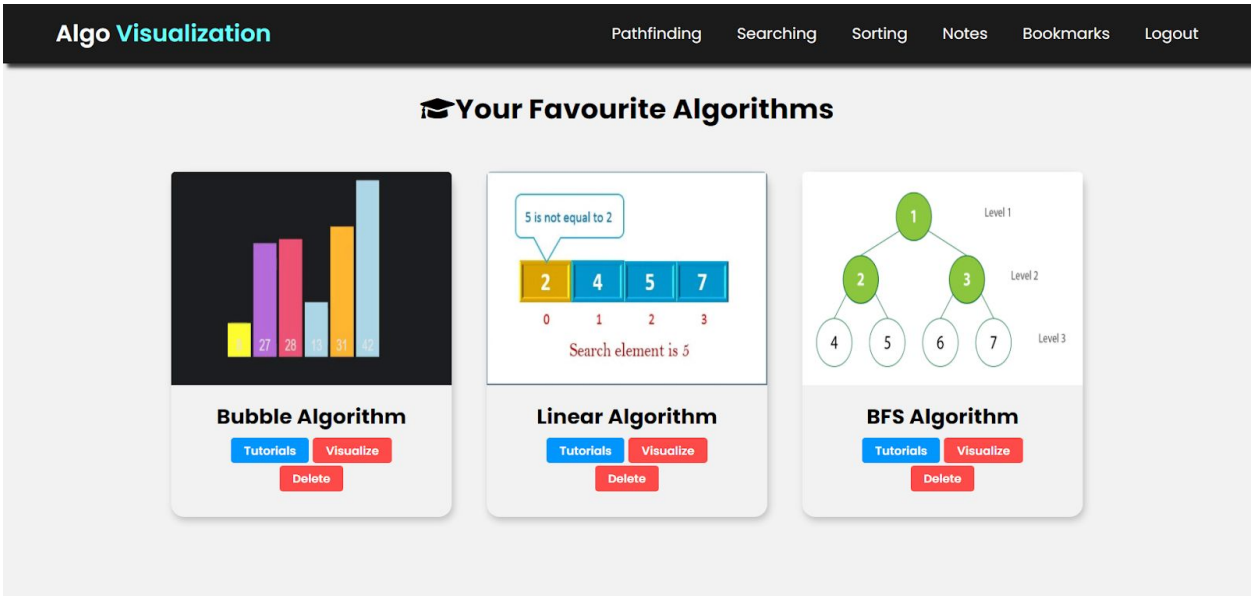


3. Visualization Page for Sorting

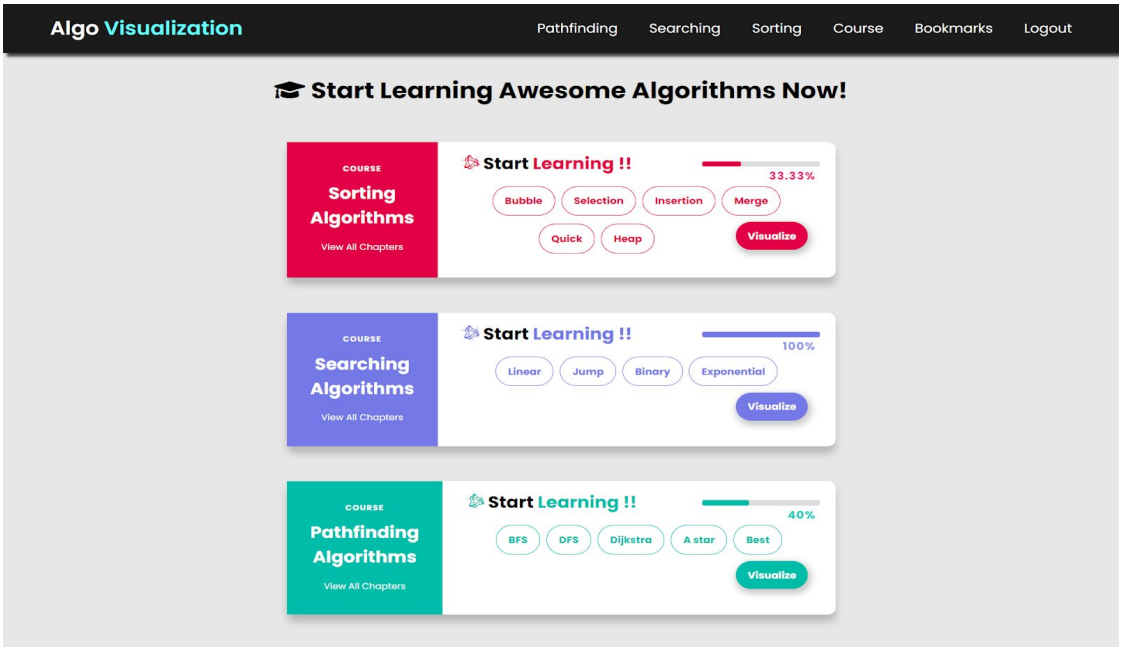


Login-Register Page- In Order to access the notes and bookmark page the user must be authenticated. For this you can login or if you are visiting the website for the first time you have to register yourself .An option for Sign in with Google is also available

Bookmark Page- Once you have successfully logged in you can bookmark your favourite algorithms and visit them in bookmarks Page



Course Page- In this page the user can keep a detailed track about how much percentage he has completed or how much percentage is still yet to be done



Chapter 7

Testing And Security

Form and Email Validation

Validation is provide through the use of HTML and Vanilla Javascript regex feature

```html
<form action="authentication.php" class="input-group" id="register" method="POST">
    <input type="text" name="name" class="input-field" placeholder="Name" required>
    <input type="email" name="email" id="email" class="input-field" placeholder="Email" required>
    <input type="password" name="password" class="input-field" placeholder="Password" required>
    <button class="submit-btn" type="submit" name="register" onclick="return validateEmail()">Register</button>
    <!-- <div class="execute" style="visibility: hidden;"></div> -->
</form>
```

```javascript
function validateEmail(e) {
    var regx = /^([a-zA-Z\.-_]+)@([a-z0-9-]+).([a-z]{2,8})$/;
    if (regx.test(mail)) {
        window.open('authentication.php', '_self')
        return true;
    }
    e.preventDefault();
    alert("You have entered an invalid email address!");
    mail.focus();
    return false;
}
```

We also have integrated Google Api for Sign in option for the ease of users.

And as for the forgot password section we send user Mail containing the link to generate a new password using the php mail service.

Form validation is done on both sides, client as well as server side to provide extra layer of security.

Password Encryption

It uses AES-128 bit encryption to encrypt user password and provide better security

```php
if (filter_var($email, FILTER_VALIDATE_EMAIL)) {
    $ciphering = "AES-128-CTR";
    $iv_length = openssl_cipher_iv_length($ciphering);
    $options = 0;
    $encryption_iv = '2345678910111211';
    $encryption_key = "DE";

    $encryption = openssl_encrypt(
        $password,
        $ciphering,
        $encryption_key,
        $options,
        $encryption_iv
    );
```

SQL Injection

We use a built in php function to prevent SQL injection.

```php
if (isset($_POST['login'])) {
    $email = mysqli_real_escape_string($con, $_POST['email']);
    $password = mysqli_real_escape_string($con, $_POST['password']);

    $ciphering = "AES-128-CTR";
    $iv_length = openssl_cipher_iv_length($ciphering);
    $options = 0;
    $encryption_iv = '2345678910111211';
    $encryption_key = "DE";

    $encryption = openssl_encrypt(
        $password,
        $ciphering,
        $encryption_key,
        $options,
        $encryption_iv
    );

    $query = "select * from auth where email = '$email' and password = '$encryption'";
    $run_query = mysqli_query($con, $query);
    $count_rows = mysqli_num_rows($run_query);
    if ($count_rows == 0) {
        echo "<script>alert('Please Enter Valid Details');</script>";
        echo "<script>window.open('authentication.php','_self')</script>";
    }
    while ($row = mysqli_fetch_array($run_query)) {
        $id = $row['user_id'];
        $name = $row['name'];
    }

    $_SESSION['user_id'] = $id;
    $_SESSION['name'] = $name;
    $_SESSION['email'] = $email;

    echo "<script>window.open('index.php','_self')</script>";
}
```

Chapter 8

Website Launching

Steps For Website Launching

1. Select and register a domain name.
2. Find, choose and purchase web hosting.
3. Make a backup copy of your website files.
4. Strive to make your website easy to navigate.
5. Validate your code.
6. Implement a site map.
7. Test your website in a variety of web browsers.
8. Ensure that you're using SEO-friendly code.
9. Install website analytics to keep track your website’s success and current status.
10. Transfer your website’s files to your web host.

You Can Visit Our Website and start exploring awesome power of algorithms via visual in depth understanding

Link:

https://algo-visualization.000webhostapp.com/templates/

Chapter 9

Conclusion And Future Scope

Conclusion

We have successfully built an E-Learning portal for deeper understanding of Sorting, Searching and Path Finding algorithms along with dynamic pictorial representation. The bookmark feature helps in keeping a tab of favourite algorithms to access them easily later for future reference. The course completion feature helps to evaluate progress of each student. The UI helps in easy traversal across the application and its responsive feature makes it compatible across a variety of devices.

Future Scope

This project can be extended further and made more advanced. Helpful videos can be embedded which will bring about a clearer perspective in cases of some complex algorithms. Various algorithms can be compared and the learner can get a clearer view of which algorithms are used in what situations. A discussion forum can be added for almost instant doubt clarifications from peers which will be of utmost help.

Chapter 10

Appendix 1: Code Sample

Code Sample

Code For Tutorial Navigation Page

```
function display_header()
{

    $auth = "Login";
    if (isset($_SESSION['name'])) {
        $auth = "Logout";
    }


    echo "
        <nav>
        <div class='logo'><a href = 'index.php'>Algo <span>Visualization</span></a></div>

        <label for='btn' class='icon'>
            <span class='fa fa-bars'></span>
        </label>
        <input type='checkbox' id='btn'>

        <ul>
        ";

    if (!isset($_SESSION['email'])) {
        echo "<li><a href='../templates/authentication.php'>Login</a></li>";
    }

    echo "
            <li>
                <label for='btn-1' class='show'>Pathfinding + </label>
                <a href='#'>Pathfinding</a>
                <input type='checkbox' id='btn-1'>
                <ul>
                    ";
    get_pathfinding_algo();
    echo "
                </ul>
            </li>
            <li>
                <label for='btn-2' class='show'>Searching + </label>
                <a href='#'>Searching</a>
                <input type='checkbox' id='btn-2'>
                <ul>
                    ";
    get_search_algo();
```

```
    echo "
                    </ul>
                </li>
                <li>
                    <label for='btn-3' class='show'>Sorting + </label>
                    <a href='#'>Sorting</a>
                    <input type='checkbox' id='btn-3'>
                    <ul>
                        ";
    get_sort_algo();
    echo "
                    </ul>
                </li>";


    if (isset($_SESSION['email'])) {
        echo "
                <li><a href='#'>Notes</a></li>
                <li><a href='#'>Bookmarks</a></li>
                ";
    } else {
        echo "
                <li><a href='../templates/invalid_access.php'>Notes</a></li>
                <li><a href='../templates/invalid_access.php'>Bookmarks</a></li>
                ";
    }

    if (isset($_SESSION['email'])) {
        echo "<li><a href='logout.php'>Logout</a></li>";
    }

    echo "</ul></nav>";
}
```

```php
<?php
include("../functions/display_functions.php");
include("../config/db.php");
?>

<!DOCTYPE html>
<html>
<head>
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="../css/homepage.css">
    <link rel="icon" href="../images/logo.png">
    <script src="https://kit.fontawesome.com/a076d05399.js"></script>
    <title>Algo Visualization</title>
</head>

<body>
    <?php display_header(); ?>

    <br>
    <h1 class="container"><i class="fas fa-graduation-cap"></i> Explore Awesome Algorithms !</h1>
    <br>
    <div class="card-deck">
        <?php
        if (isset($_GET['grp_id'])) {
            $id = $_GET['grp_id'];
            print_cards($id);
        }
        ?>
    </div>
</body>
</html>
```

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THE END...