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A
Mini project report on

"SORTING ALGORITHMS VISUALIZER"

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CERTIFICATE

Certified that the project work entitled **"Sorting Algorithms Visualizer"** carried out by **JAFFER NAVEED(1AT17IS032), NEHA PRAKASH(1AT17IS057)** are bonafide students of **ATRIA INSTITUTE OF TECHNOLOGY**, Bengaluru, in partial fulfillment for the award of Degree of **Bachelor of Engineering** in **Information Science & Engineering** of **Visvesvaraya Technological University, Belagavi,** during the academic year **2020-21**. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. The mini project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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1.	
2.	

DECLARATION

We, **JAFFER NAVEED (1AT17IS032)**, **NEHA PRAKASH (1AT17IS057)** students of **7th semester, Bachelor of Engineering, Department of Information Science and Engineering, Atria Institute of Technology, Bengaluru,** would hereby declare that the mini project entitled **"Sorting Algorithms Visualizer"** has been carried out by us at **Atria Institute of Technology, Bengaluru,** and submitted in partial fulfillment of the course requirement for the award of degree of **Bachelor of Engineering in Information Science and Engineering** of **Visvesvaraya Technological University, Belagavi,** during the academic year **2020-21.**

We further declare that the work embodied in this report has not been submitted to any other university or institution for the award of any other degree.

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ABSTRACT

Algorithms is one of the most important topics in computer science engineering. There are a lot of different algorithms which perform the same task but differ in implementation details and complexities. It is very easy to get confused between all the different algorithms or it might be difficult to understand how they actually work.

The purpose of the Sorting Algorithms Visualizer is to help users get a better understanding of how sorting algorithms work through visualizations. Users can also compare the time and space complexities of various algorithms on the website. The users can adjust the size of the array to be sorted, the speed of the visualization and the algorithm to be used for sorting. User can also see how various algorithms perform in case of an already sorted array.

The aim is to help learners grasp the concept of sorting algorithms better. Learners can be both students or teachers. Project will also be use for personal use. Basically, the project describes the working for various sorting algorithms visually.

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CHAPTER – 1

INTRODUCTION

1.1 INTRODUCTION TO WEB TECHNOLOGY

1.2 WEB TECHNOLOGIES

Web technology is the mechanism which enables two computer devices to communicate over a network. In a normal office setting, for example, quite a few computers and additional devices like printers might be connected allowing for suitable and fast transmission of data. The procedures are varied and complicated, which explains companies employ departments to take care of the matter. Internet technologies have generated surgeries a lot more efficient and have revolutionized communication techniques.

The most important benefit of internet technologies is that it provides convenience and a higher speed of communicating in the computer world. Internet technology makes it possible for messages whereas earlier it might have been required to depart from your workspace or to use a runner.

1.2.1 HTML

Hypertext Markup Language (HTML) is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

Features of HTML:

- Web browsers receive HTML documents from a web server or local storage and render the documents into multimedia web pages.
- HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.
- HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects such interactive forms may be embedded into the rendered page.

- HTML provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, link, quotes and other items.
- HTML elements are delineated by tags, written using angle brackets. Tags such as <img /> and <input />

Advantages of HTML:

- HTML is widely used.
- Every browser supports HTML Language.
- Easy to learn and use.
- Do not need to purchase any extra software because it is by default in every window.

Disadvantages of HTML:

- HTML can create only static and plain pages so if we need dynamic pages then HTML is not useful.
- Need to write a lot of code for making a simple webpage.
- Security features are not good at HTML.
- If we need to write a long code for making a webpage then it produces some complexity.[1]

1.2.2 CSS

Cascading Style Sheets (CSS) is a stylesheet language used for describing the presentation of a document written in a markup language such as HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.

CSS is designed to enable the separation of presentation and content, including layout, colours, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics, and enable multiple web pages to share formatting by specifying the relevant CSS in a separate.

Advantages of CSS:

- CSS plays an important role, by using CSS you simply have to specify a repeated style for the element once & use it multiple times as because CSS will automatically apply the required styles.
- The main advantage of CSS is that style is applied consistently across a variety of sites. One instruction can control several areas which are advantageous.
- Web designers need to use a few lines of programming for every page improving site speed.
- It is less complex therefore the effort is significantly reduced.
- These bandwidth savings are substantial figures of insignificant tags that are indistinct from a mess of pages.
- It reduces the file transfer size.

Disadvantages of CSS:

- CSS, CSS 1 up to CSS3, result in creating confusion among web browsers.
- After making the changes we need to confirm the compatibility if they appear. The similar change affects all the browsers.
- Browser compatibility (some styles sheet are supported and some are not).
- CSS works differently on different browsers. IE and Opera support CSS as different logic.
- There might be cross-browser issues while using CSS.
- There are multiple levels which create confusion for non-developers and beginners.[2][3]

1.2.3 JavaScript

JavaScript is a cross-platform, object-oriented, dynamic scripting language used to make webpages interactive.

The programs in this language are called scripts. They can be written right in a web page's HTML and run automatically as the page loads.

Scripts are provided and executed as plain text. They don't need special preparation or compilation to run.

JavaScript contains a standard library of objects, such as Array, Date, and Math, and a core set of language elements such as operators, control structures, and statements. Core JavaScript can be extended for a variety of purposes by supplementing it with additional objects; for example:

- *Client-side JavaScript* extends the core language by supplying objects to control a browser and it's Document Object Model (DOM). For example, client-side extensions allow an application to place elements on an HTML form and respond to user events such as mouse clicks, form input, and page navigation.
- *Server-side JavaScript* extends the core language by supplying objects relevant to running JavaScript on a server. For example, server-side extensions allow an application to communicate with a database, provide continuity of information from one invocation to another of the application, or perform file manipulations on a server.

Features of JavaScript in browser:

- Add new HTML to the page, change the existing content, and modify styles.
- React to user actions, run on mouse clicks, pointer movements, and key presses.
- Send requests over the network to remote servers, download and upload files (so-called AJAX and COMET technologies).
- Get and set cookies, ask questions to the visitor, show messages.
- Remember the data on the client-side ("local storage").

Advantages of JavaScript:

- Less server interaction − It can validate user input before sending the page off to the server. This saves server traffic, which means less load on your server.
- Immediate feedback to the visitors − Users don't have to wait for a page reload to see if they have forgotten to enter something.
- Increased interactivity − It can create interfaces that react when the user hovers over them with a mouse or activates them via the keyboard.

- Richer interfaces – It can be used to include items such as drag-and-drop components and sliders to give a Rich Interface to your site visitors.

Limitations of JavaScript:

- Client-side JavaScript does not allow the reading or writing of files. This has been kept for security reason.
- JavaScript cannot be used for networking applications because there is no such support available.
- JavaScript doesn't have any multi-threading or multiprocessor capabilities.[4]

1.2.4 PHP

PHP is a server-side scripting language that is used to develop Static websites or Dynamic websites or Web applications. PHP is a widely-used, open-source scripting language. PHP scripts are executed on the server. PHP is known as the general-purpose programming language. It is used as a server-side scripting language that is mainly used for the development of web sites.

The PHP frameworks also make web development easier. This framework helps in reusing the same code and there is no need to write the lengthy and complex code for the web applications. PHP frameworks are mainly open source and can be used easily.

PHP code is executed on the server, and the result is returned to the browser as plain HTML. PHP files have extension ".php"

PHP Features:

- PHP can generate dynamic page content
- PHP can create, open, read, write, delete, and close files on the server
- PHP can handle forms, i.e. gather data from files, save data to a file, through the email you can send data, return data to the user.
- PHP can send and receive cookies
- PHP can add, delete, modify data in your database

- PHP can be used to control user-access i.e.: using PHP, you can restrict users to access some pages of your website.
- PHP can encrypt data

Advantages of PHP:

- The application can easily be loaded which are based on PHP and connected to a database. It's mainly used due to its faster rate of loading over slow internet and speed than another programing language.
- It helps in reusing an equivalent code and no got to write lengthy code and sophisticated structure for an event of web applications.
- It helps in managing code easily.
- PHP's built-in database connection modules help in the connecting database easily reduce trouble and time for the development of web applications and content-based sites.

Disadvantages of PHP:

- It is not that secure due to its open-source, because the ASCII text files are often easily available.
- Using more features of PHP framework and tools cause poor performance of online applications.
- PHP don't allow change or modification in core behavior of online applications
- It is widely believed by the developers that PHP features a poor quality of handling errors. PHP lacks debugging tools, which are needed to look for errors and warnings.[5]

1.2.5 jQuery

jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write

JavaScript. jQuery also simplifies a lot of the complicated things from JavaScript, like AJAX calls and DOM manipulation.

Features of jQuery:

- HTML/DOM manipulation
- CSS manipulation
- HTML event methods
- Effects and animations
- Utilities

Advantages of jQuery:

- **Ajax support:** jQuery lets you develop Ajax templates with ease, Ajax enables a sleeker interface where actions can be performed on pages without requiring the entire page to be reloaded.
- **Ease of use:** This is pretty much the main advantage of using jQuery, it is a lot easier to use compared to standard JavaScript and other JavaScript libraries. Apart from simple syntax, it also requires much fewer lines of code to achieve the same feature in comparison.
- **Great documentation and tutorials:** The jQuery website has comprehensive documentation and tutorials to get even an absolute beginner in programming to get the ball rolling with this library.

Limitation of jQuery:

- **Functionality may be limited:** While jQuery has an impressive library in terms of quantity, depending on how much customization you require on your website, the functionality may be limited thus using raw JavaScript inevitable in some cases.

- **jQuery JavaScript file required:** The jQuery JavaScript file is required to run jQuery commands, while the size of this file is relatively small (25-100KB depending on the server), it is still a strain on the client computer and maybe your web server as well if you intend to host the jQuery script on your own web server. [6]

1.3 ADVANTAGES OF WEB APPLICATIONS

- Zero install - all PCs have a browser.
- Centralized data is secure and easy to backup.
- Quick and easy updates.
- Reach anybody, anywhere in the world.
- Available 24 hours a day, 7 days a week.
- Low spec PCs or smartphones can be used.
- Online training can be completed at the user's own time and pace.
- Direct access to the latest information
- Always up-to-date.

CHAPTER 2

INTRODUCTION TO PROJECT

SORTING ALGORITHMS VISUALIZER

2.1 BRIEF DESCRIPTION

The mini-project entitled “Sorting Algorithms Visualizer“ is developed as a part of the seventh semester WT laboratory, for the partial fulfillment of the requirement for the BE (Information Science) course.

2.2 PROJECT DESCRIPTION

“Sorting Algorithms Visualizer” is a Web Application that provides users with beautiful visualizations of sorting algorithms. Users can also compare the time and space complexities of various algorithms on the website. The users can adjust the size of the array to be sorted, the speed of the visualization and the algorithm to be used for sorting.

Therefore, this system provides users with a better understanding of sorting algorithms though visualizations.

2.3 OBJECTIVES

The main objective of the Project on Sorting Algorithms Visualizer is help users get a better understanding of how sorting algorithms work through visualizations.

- The user should also be able to choose between different sorting algorithms.
- Compare the time and space complexities of various algorithms and data structures.
- Be easy to understand by the user and operator.
- Be easy to operate.
- Have a good user interface.

2.4 SCOPE

The project can be useful for the following purposes:

- For educational purpose to get a better understanding of various sorting algorithms.
- It can be used by both teachers and students.

CHAPTER - 3

SYSTEM REQUIREMENTS AND SPECIFICATIONS

3.1 Functional And Non-Functional Requirements

3.1.1 FUNCTIONAL OR SPECIFIC REQUIREMENTS

The required software is used for visualizing sorting algorithms. The system should satisfy the following requirements:

1. Home Page
2. Visualization Page
3. Compare Algorithm Complexities Page
4. Option To Choose Sorting Algorithm
5. Option To Adjust Array Size
6. Option To Adjust Visualization Speed

3.1.2 NON-FUNCTIONAL REQUIREMENTS

The server hardware can be any computer capable of running javascript handling the expected traffic. For a small scale project that is not expecting to see much web traffic, an average personal computer may be appropriate. Once the site starts generating more hits, though, it will likely be necessary to upgrade to a dedicated host to ensure proper performance. The exact cut-offs will need to be determined through a more thorough stress testing of the system.

3.2 HARDWARE REQUIREMENTS

- Processor: Pentium 2 or higher
- Processor clock: 500 MHz
- Hard disk space: 500MB
- Ram: depending on the usage: Usually around 300MBs
- Windows 7 or 8 or 10 Operating system.

3.3 SOFTWARE REQUIREMENTS

- Programming language: JAVASCRIPT, HTML, CSS
- Browser with enabled JavaScript.

CHAPTER 4

DESIGN

4.1 APPLICATION FLOW DIAGRAM:

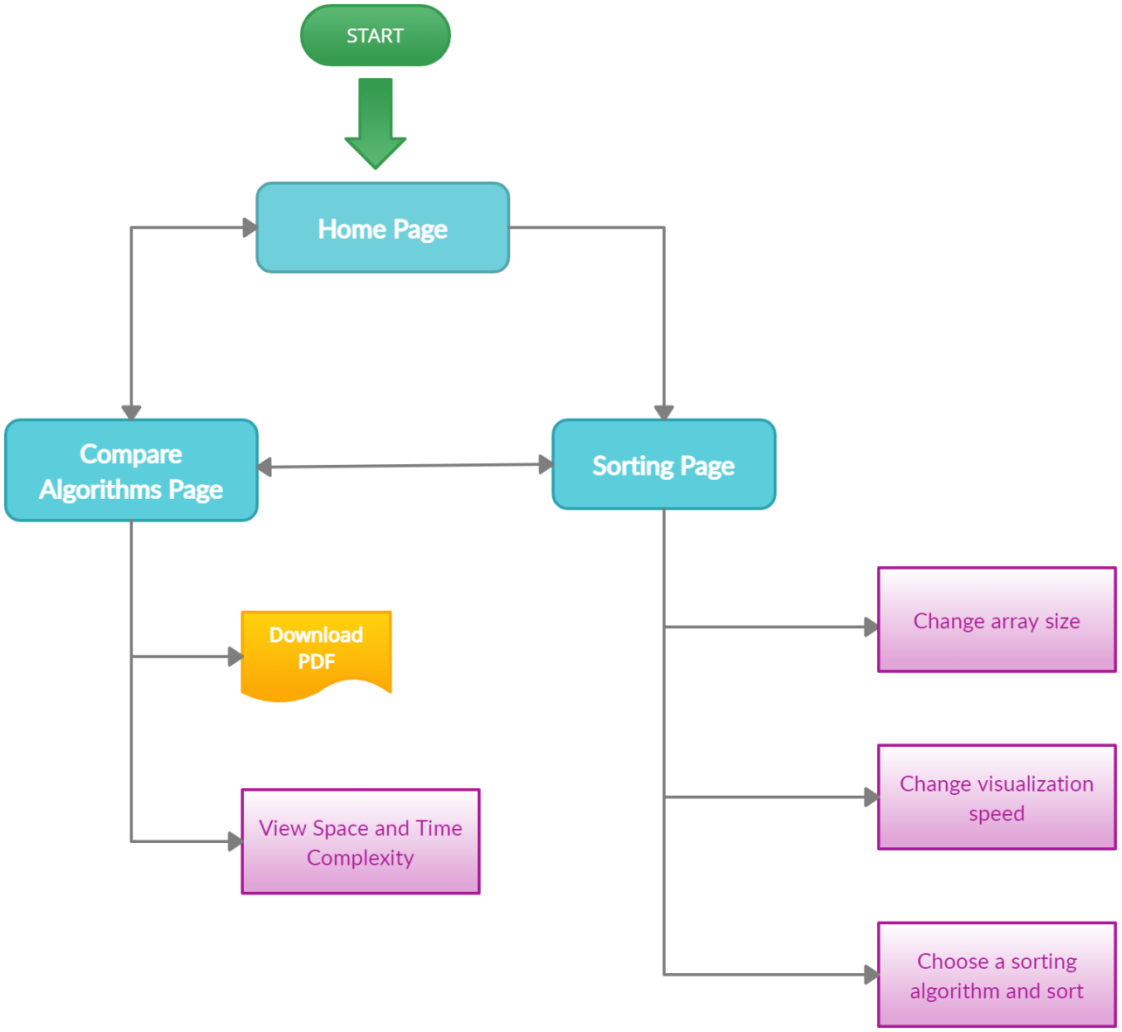

Fig 4.1: Application Flow Diagram

Figure 4.1 shows the application flow diagram for the project. The home page has options to go to Sorting Page and Algorithms Comparison Page. It also has links to github and linkedin profile. From the Sorting Page the user can choose the type of sorting algorithm to visualize. The user can also adjust the size of array and speed of visualization. The user can also go to Compare Algorithms Page. From the Compare Algorithms Page the user can navigate to Sorting Page and Home Page. The can also download or view the space and time complexities of various algorithms.

CHAPTER 5

IMPLEMENTATION

5.1 HOME PAGE

The Figure 5.1 above is first page the user sees when the user visits our web site. This page allows users to navigate the entire application through the navigation bar on top or by scrolling down to services. Firgure 5.2 and 5.3 shows what home page looks like when scrolled down.

Fig 5.1: Home Page

Fig 5.2: Home Page Service 1

Fig 5.3: Home Page Service 2

5.2 SORTING VISUALIZER PAGE

The Figure 5.4 shows the Sorting Visualizer Page where user can view beautiful visualizations for various sorting algorithms.

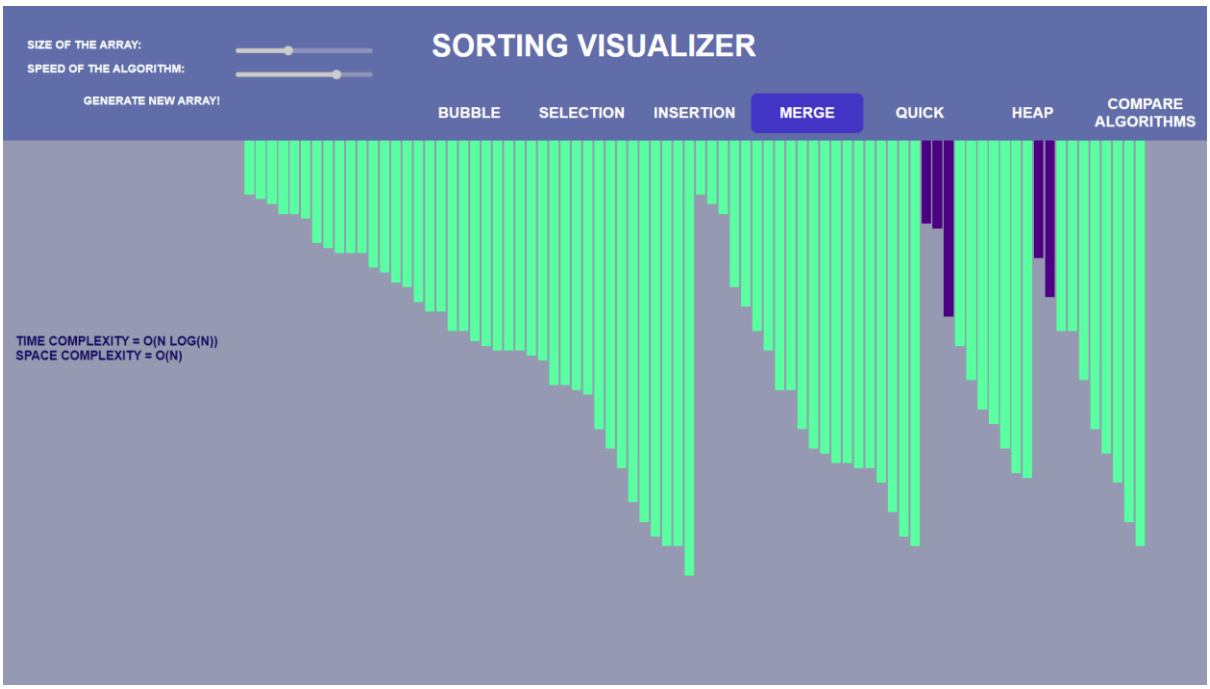

Fig 5.4: Sorting Visualizer Page

5.3 COMPARE ALGORITHMS PAGE

The Figure 5.5 and Figure 5.6 shows the Compare Algorithms Page where user can compare the time and space somplexities of various sorting algorithms. The user can also download this page as a PDF or navigate to other pages using the options in the navbar at the top.

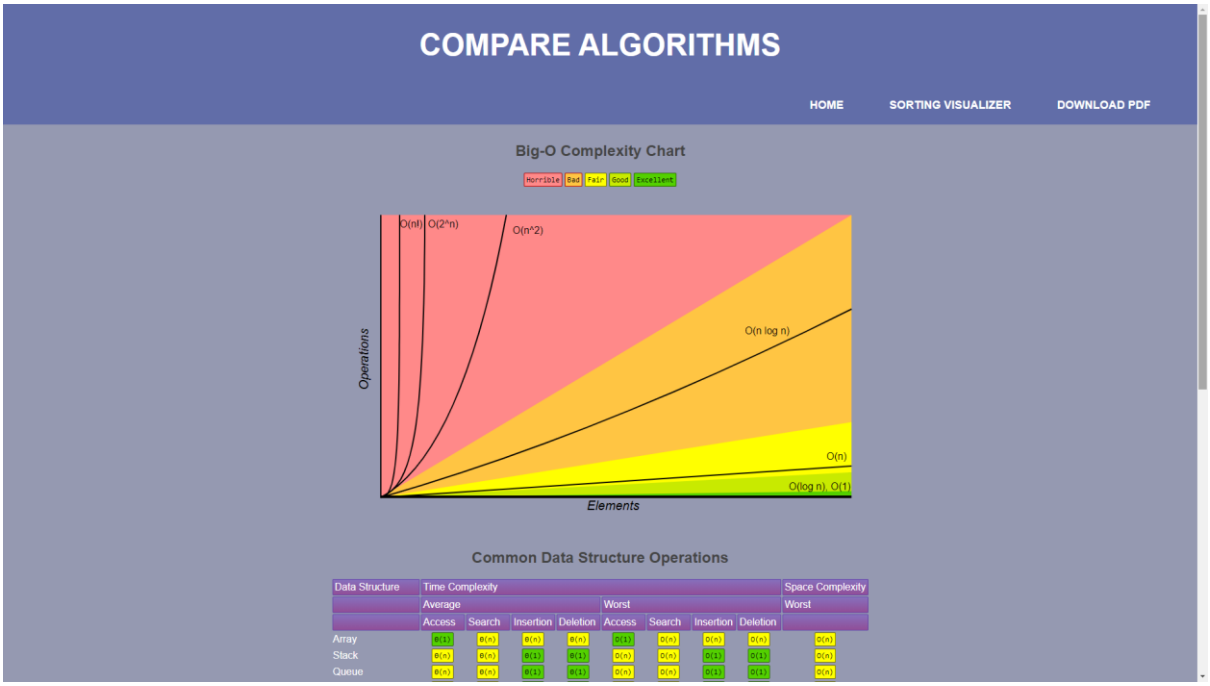

Fig 5.5: Compare Algorithms Page

Fig 5.6: Compare Algorithms Page on scrolling

CONCLUSION AND FUTURE ENHANCEMENTS

The Sorting Algorithms Visualizer makes it easier for the user to understand how various sorting algorithms work through colourful visualizations. The system can be used in educational institutions by both teachers and students or even for personal use.

The platform is easy to navigate and provides various options to choose between sorting algorithms or change the array size for sorting and even to change the speed of visualization.

In a nutshell, it can be summarized that the future scope of the project circles around maintaining information regarding:

- There can be more sorting algorithms included in the website.
- Apart from sorting algorithms we can include other algorithms such as path finding algorithms or tree algorithms.
- There can be a functionality to display the visualization for all the sorting algorithms, for the same elements, simultaneously, for better comparison.
- The UI can be improved by better graphics to make the website more appealing.
- Instead of sorting array of numbers we can sort pixels in images, sound waves, etc.
- We will host the platform on online servers to make it accessible worldwide.
- Integrate multiple load balancers to distribute loads of the system.
- Create the master and slave database structure to reduce the overload of thedatabase queries.

The above-mentioned points are the enhancements that can be done to increase the applicability and usage of this project.

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