IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Data Structure And Algorithm Visualization

[1]**Mr.REVANASHIDDAYYA MALAGITTI,** Lecturer, Dept of CSE,
Government Polytechnic Gajendragad

[2]**Mr. SIRAJDDOLA NADAF,** Lecturer, Dept of CSE,
Government Polytechnic Vijayapur

***Abstract*—** These days, algorithms and data structures are crucial to computer science since they enable us to store, process, and analyze vast amounts of data. Several techniques are used in data structures to arrange the data. We think that seeing the minaction is the greatest method to comprehend algorithms and data structures. For a range of algorithms, we created interactive visualizations that are simple enough for the human brain to comprehend and use. The goal of this project's development is to make algorithms simply understandable to humans. Additionally, this effort improved our understanding of algorithms and data structures. Traditionally, theoretical and mathematical analysis has been used to examine data structures and algorithms. As a result, it is time-consuming, difficult to study, and lacks understanding of how an issue is applied in real life. We have created and supplied an idea, data structures, and algorithm to help teachers and students visualize data structures and algorithms with their real-world implementation.

Keywords:-visualization, Interface, Application layer

I. INTRODUCTION

Data structures provide abstraction, productivity, and reuse. A program's main goal is to save and retrieve user data as rapidly as possible, hence it contributes significantly to performance improvement. It is impossible to exaggerate the significance of algorithms and data structures in computer science. Data structures allow us to store and organize information, while algorithms allow us to process it in a meaningful way. Undergraduate students and novice programmers find it difficult to understand data structure courses in computer science. Common data structures are used in many computing problems. Additionally, it can be difficult to help our students understand what is going on inside a particular built-in implementation of a data structure. The goal of our research is to develop a dynamic visualization tool that requires less work from students in order to provide a more effective visualisation of the collection of data pieces relating to the data structures being studied. By employing run-time detection to the data structures, we can see the data pieces and the corresponding structures to enhance the learning experiences of the students.

Data visualisations are highly successful because they rebalance vision and cognition to better exploit brain capabilities. Algorithm design, debugging, and student instruction can all benefit from algorithm visualization. When the visualization incorporates the environment, the sefulness of the visualisation for understanding can increase.DSA is a subject that can be learned via a variety of books, lectures, online classes, etc.; nonetheless, users may find it more engaging if they can visualize the data structures and algorithms. By igniting their imagination, learners are better able to visualize topics with real-world applications.To develop Visualization in web we implemented HTML Canvas which is basically used to draw graphics via JavaScript.

The main motivation of the project “VISDAA” is to understand Data structure and Algorithm by Visualization which human brain can easily catch and implement. The project described in this project features the following features.

- Full visualisation is provided for frequently used data structures including arrays, stacks, queues, lists, sorting and searching methods, etc.
- provides the animation of common data structure actions, like adding and removing items, among many others.
- Animation of basic user-defined algorithms is provided..

II. OBJECTIVES

- The main objective of this project is understanding the Data Structure and Algorithm easily and effectively through graphical representations.
- To give user some of the popular operations in Data structure to perform and visualize with animation because human brain can understand visualization better than theory and pseudocode.
- User friendly interface of the website makes it easier for user to utilize features.
- Our project makes easier any one to understand data structures ADT through visualization and provide free access anywhere.
- Making our project available throughout different kind of devices by developing both responsive Website and App.

III. PROPOSEDRESEARCH

The goal of the proposed study is to provide a visualization tool for algorithms and data structures that will aid students in understanding these ideas. Users will be able to examine the behavior of various data structures and algorithms in real time thanks to the tool's interactive visuals.

A literature analysis of current visualization tools for data structures and algorithms, the identification of the best visualization techniques, and the design and development of the visualization tool are some of the phases that will comprise the research.

A user-friendly and efficient visualization tool that can be utilized as a teaching tool in computer science classes or by anybody wishing to better comprehend data structures and algorithms is the anticipated result of the project. Additionally, the tool might be used for study to examine how well various data structures and algorithms work.

IV. BACKGROUNDOFRESEARCH

Algorithms and data structures are fundamental ideas in software engineering and computer science. However, particularly for novices, they might be intricate and challenging to comprehend. It has been discovered that using visualization tools to assist students grasp these ideas works well.

One well-liked programming language for web development is JavaScript. Additionally, it is an effective language for making dynamic and interactive infographics. Because JavaScript is so accessible and user-friendly, there is increasing interest in using it to create visualization tools for data structures and algorithms.

Existing JavaScript-based visualization tools for data structures and algorithms have demonstrated potential in improving students' comprehension of these ideas. To determine the best visualization strategies for teaching data structures and algorithms with JavaScript, more study is still required.

By leveraging JavaScript to create a web-based visualization tool for data structures and algorithms, the proposed study seeks to close this gap. For students at all skill levels, the tool will offer an engaging and interactive learning environment.

The research will also contribute to the broader field of computer science education by providing insights into the most effective visualization techniques for teaching data structures and algorithms using JavaScript. The research findings could inform the development of more effective teaching strategies for computer science educators and could lead to the development of more advanced visualization tools for analyzing the performance of different algorithms and data structures.

V. HYPOTHESIS

The use of interactive and engaging visualization tools for data structures and algorithms using JavaScript can enhance learners' understanding of these concepts.

The effectiveness of visualization techniques for teaching data structures and algorithms using JavaScript depends on factors such as the type of data structure or algorithm being taught, the level of learners, and the context of the learning environment.

The development of a comprehensive and customizable web- based visualization tool for data structures and algorithms using JavaScript can improve learners' engagement, motivation, and learning outcomes.

For students studying data structures and algorithms, the application of 3D visualization techniques can offer a more engaging and productive learning environment.

Using gamification strategies like leader boards, badges, and awards can increase students' enthusiasm and involvement in the JavaScript data structures and algorithm visualization learning process.

The overall goal of the hypotheses is to investigate how visualization, 3D visualization, and gamification strategies could improve the way that JavaScript data structures and algorithms are learned. Through user testing with students at various skill levels and empirical evaluation, the study will assess these hypotheses.

VI. METHODOLOGY

Visualizers are the models that come to implement a particular data structure. We consider code that is reusable and easily maintainable to be good, efficient, and optimized. Therefore, by developing a distinct package for the functions or code that can be used to generate another data structure and algorithm visualizer, we are attempting to realize the OPPs notion. We must first fully comprehend the data structures or algorithm before we can create any data structure visualizer. For this reason, we are utilizing Java to create the data structure or algorithm in order to gain an understanding of how it can be done.

Methodology and approach to be adopted are follows: Literature Review: A thorough review of the literature will be done to determine the best visualization methods for teaching JavaScript data structures and algorithms, as well as the best tools and libraries for visualizing these types of systems, as well as the potential benefits of 3D visualization and gamification for improving the learning process.

Tool Design and Development: JavaScript, HTML, and CSS will be used in the design and development of a web-based visualization tool. The program will have gamification aspects, user customization choices, and interactive and captivating visuals for various data structures and algorithms.

Empirical Evaluation: Students at various skill levels will participate in an empirical evaluation of the produced tool. In addition to comparing the efficacy of various visualization techniques, the evaluation will determine how well the tool enhances learners' comprehension, engagement, and motivation.

User Testing: The developed tool will be tested with a sample of learners to assess its usability, user satisfaction, and learning outcomes. User testing will involve gathering data on users' performance, feedback, and preferences.

Data Analysis: The data collected through the empirical evaluation and user testing will be analyzed using descriptive statistics, inferential statistics, and qualitative analysis techniques.

Results and Conclusion: The findings from the data analysis will be used to evaluate the research hypotheses, draw conclusions, and provide recommendations for the development of more effective visualization tools for data structures and algorithms using JavaScript.

In order to assess how well visualization techniques, 3D visualization, and gamification techniques can improve the learning experience of data structures and algorithms using JavaScript, this methodology or approach combines literature review, tool design and development, empirical evaluation, and user testing.

Architectural design:
The presentation layer, the application layer, and the data layer are the three primary levels that make up the suggested architecture for the data structure and algorithm visualization platform.

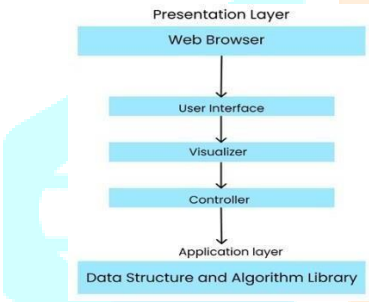

Figure 2 Architectural design.

Presentation Layer: The presentation layer must offer an intuitive user experience for users to interact with the platform. The user interface elements, such as interactive elements, visualizations, and web page layout, are included in this layer. HTML, CSS, and JavaScript are used in the construction of the display layer. D3.js, a robust JavaScript data visualization framework, is used to build the visuals.

Application Layer: At the application layer, user requests are processed and pertinent responses are generated. It includes the business logic that controls the platform's operation. JavaScript is used to create this layer, and Node.js, a platform for creating scalable network applications, is used to run it on the server side.

Data Layer: The data layer is responsible for maintaining the data used by the application layer. Along with the data structures and techniques used by the application layer, it includes any user data. JSON and JavaScript are used to create the data layer.

.

Class Diagram:

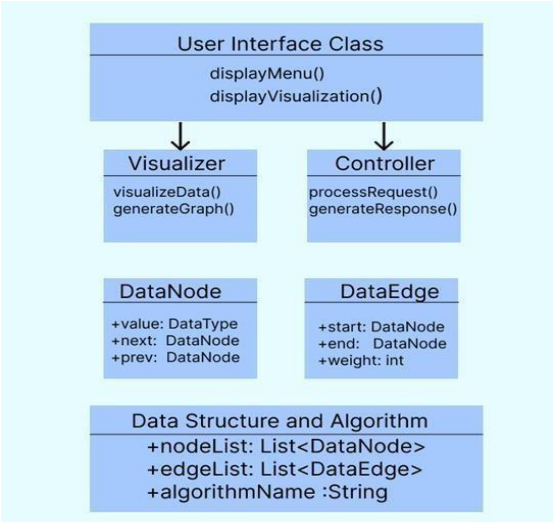

Figure 3 Class Diagram.

The class diagram illustrates the key classes and their relationships within the proposed architecture. The User Interface class is responsible for interacting with the user and displaying the appropriate menus and visualizations. The Visualizer class generates the visualizations of the data structures and algorithms, while the Controller class processes user requests and generates appropriate responses.

The DataNode represent the nodes and edges of the data structures, respectively. They include properties such as value, next, prev, start, end, and weight, which are used to define the structure and behavior of the data structures.

The DataNode and DataEdge classes represent the nodes and edges of the data structures, respectively. They include properties such as value, next, prev, start, end, and weight, which are used to define the structure and behavior of the data structures.

Sequence Diagram:

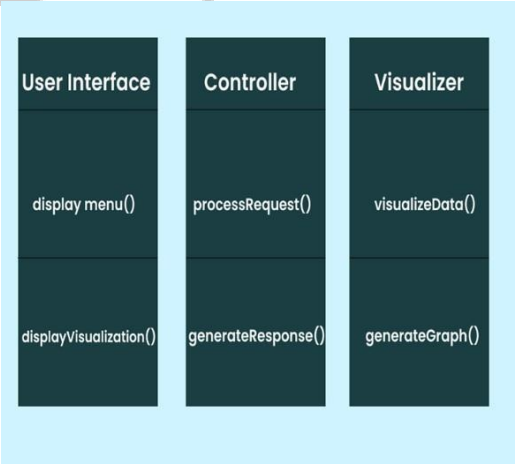

Figure 4 Sequence Diagram.

This sequence diagram illustrates the interaction between the key classes of the platform, including the UserInterface, Controller, and Visualizer classes.

The user begins by interacting with the UserInterface class, which displays a menu of available data structures and algorithms. The user selects an option from the menu, which triggers a call to the processRequest() method of the Controller class.

The Controller class processes the user request, generating an appropriate response by calling the generateResponse() method. The response is then passed back to the UserInterface class, which displays the appropriate visualization by calling the visualizeData() method of the Visualizer class.

The Visualizer class generates the appropriate graph visualization of the selected data structure or algorithm by calling the generateGraph() method. The resulting visualization is then passed back to the UserInterface class, which displays it to the user.

VII. Modules Identified

Visualizer: For visualizing purposes, we used Canvas which is used to draw a 2D and 3D diagram through graphical representation.
Operations: Each Data structure and Algorithm is going to have its own operations where the user can envision each of them through a visualizer.
Controllers: Controllers contain options for users to control the height and width of the visualizer and animation speed.

VIII. RESULT

Over all output's snip diagram is shown in below Figure shows the end result

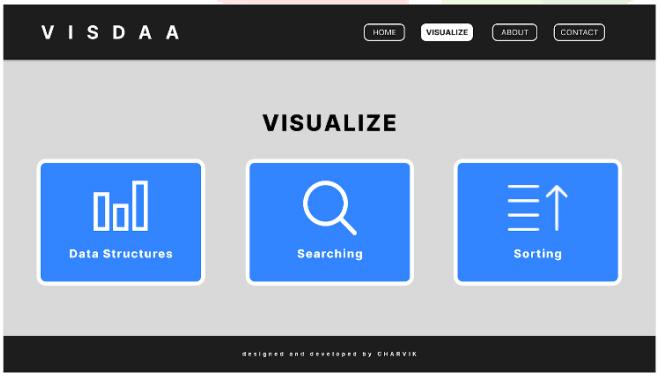

Figure 1 Home Page

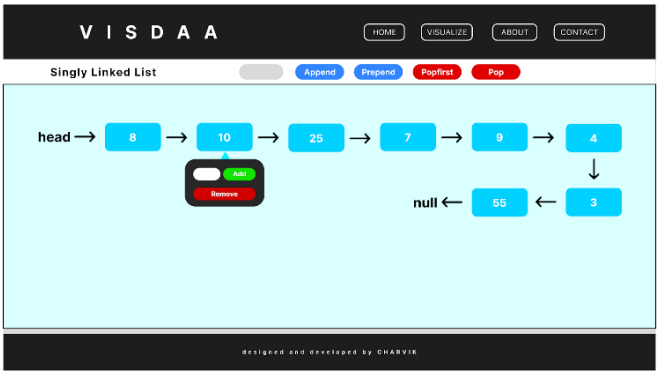

Figure 2 Singly LinkedList

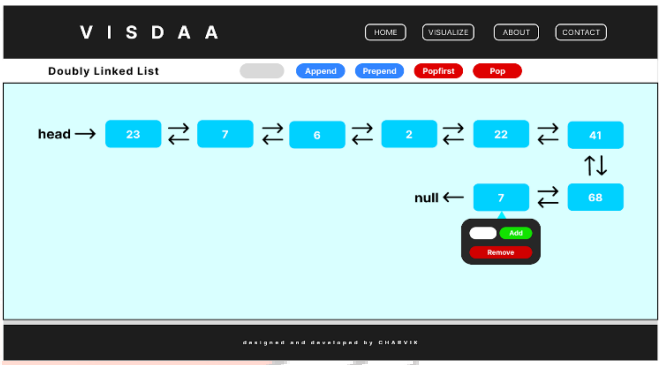

Figure 3 Doubly LinkedList

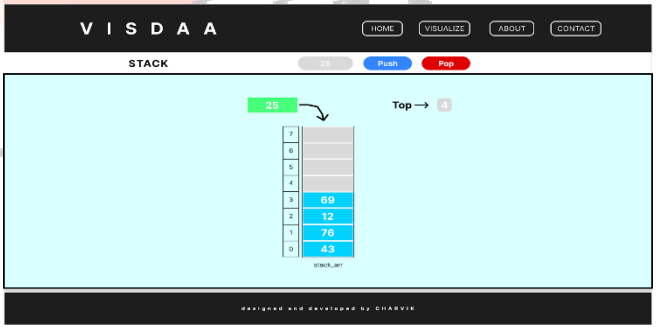

Figure 4 Stack

IX. Conclusion

After completion of this project user can access our web application from any device and will be able to visualize most popular Data Structures ADT's. It will be useful for the teacher who want to teach their student through visualization and learner who want a better understanding of DSA or a developer who want to revise his forgotten DSA skills quickly. Best part of this project is that it's going to be an open source and freely available in GitHub anyone can contribute or read the implementation.

REFERENCES

[1] Tao Chen and Tarek Sobh,"A Tool for Data Structure and user-defined Algorithm", University of Bridgeport, London,2019.

[2] Yoram Moses, Zvi Polunsky, Ayellet Tal, "Algorithm Visualization for Distributed Environments", The Weizmann Institution of Science, USA,2015.

[3] Andrea Stocco, Maurizio Leotta, Filippo Ricca, Paolo Tonella, "A tool for Migrating DOM based Visual Web Tests", University of Genova, Italy,2014.

[4] Juan Lin, , Hui Zhang, "Data Structure Visualization on the web", University of Louisville, USA,2020.

[5] Ahmed Roshdy, Nada Sharaf, Madeleine Saad and Slim Abdennadher, "Generic Data Visualization platform", The German University in Cairo, Egypt,2018.

[6] Shraddha Ghadge,Virajas Mane,"A Survey paper on Data Structures and Algorithm Visualization", University of Mumbai, India,Volume:04, Issue:04, April 2022.

[7] Edy Budiman, Nataniel Dengen and Ummul Hairah , "Visualization Tools of Data Structure Course to Support Learning Students", University Mulawarman Samarinda, Indonesia, 2011.