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Algorithm Visualization

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ABSTRACT — Data structures prove to be an effective way of performing various operations related to data management including storing and arranging data along with its retrieval so that the data can be easily used and manipulated in the future as the need arises. There are various algorithms for various operations of data management. Often it becomes confusing to differentiate and remember algorithms performing similar tasks. Understanding the concepts and the flow of the algorithm, why iterations are necessary at certain times can be really demanding and stressful especially for a beginner who is not familiar with its terminologies. Here comes the need for visualization. Algorithm Visualization can aid better to learn data structures. These tools for visualizing algorithms demonstrate how the algorithm works in a visually appealing manner so that the data structure's implementation can be understood easily. When we learn a concept after visualizing it, we form its conceptual model in our mind which stays permanently thus making learning effective and fun. This forms a clear understanding of the underlying mechanics behind some confusing data structures thus building the foundation for the concepts of advanced methodologies and implementations. To make the process more interactive, we are presenting animated algorithm visualizations.

KEYWORDS – Data Structure, Algorithm Visualizer.

I. INTRODUCTION

The rapidly developing technologies have influenced education greatly. Especially the pandemic has locked us inside our homes, everything starting from education to employment has gone digital. From traditional classrooms to digital classrooms, everything has evolved. Nowadays, various instructional websites offering online courses have grown dramatically. Web-based courses have become the new trend. Instructional websites dedicated to Algorithms on Data Structures can be easily found by using Search Engines. Data Structures and algorithms are basic concepts. But many students complain it being difficult to remember the various algorithms in data structures since abstract thinking is required in order to comprehend it and grasp the concept. One way for improving instruction in this area is to include algorithm and data structure visualizations in the form of animations. A visualization tool of data structures like arrays, stacks, queues, linked lists, trees and graphs is necessary for students to experiment with thus, allowing students to see the actual process of an element being inserted into or deleted from different data structures, how a tree is traversed in different orders (pre-order, in- order, post-order, level-order) etc. Good Algorithmic Visualizers have the capability to bring algorithms to life by illustrating data structures in natural, abstract ways and animating their various states. We are presenting a data structure visualization tool designed to animate standard manipulations of several common data structures. The platform is intended for use by students to thorough themselves with the subject as well as instructors who wish to enhance their lectures with an animated interface.

II. LITERATURE REVIEW

We surveyed papers aimed to examine the effect of instruction using this method in which students constructed visualizations on their programming achievement and their attitudes toward computer programming, exploring how such tools support their learning enquiring their self-reported experiences in the course where visualizations related to sorting were constructed. The resulting serial of key frames featuring major data structure transformation are available for

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review and analysis. All these combines to fill the gap between the abstract data representation and a dynamic learning-by coding process. It has been observed that Algorithm Visualisation (AV) tools help learners to learn the actual working of algorithms and data structures. Most of them cover basic data structure algorithms like sequential data structures such as arrays, stacks, queues, linked lists, sorting and searching algorithms. Some of the algorithm visualizers are in the format of packages that allow students or instructors to implement independently in any scripting language. Visualizations that can be directly accessed from web pages will naturally get more attention from potential users, since they do not have to go through the additional step of downloading and unpacking a visualization system. Most of the visualization platforms that we have encountered either does not have a user-friendly interface, or are a bit complicated to understand. Mostly these platforms lack interactive multimedia. The user does not actively play any role in the majority of existing platforms, being mere observers with no control over input values or the pace of observing the animations.

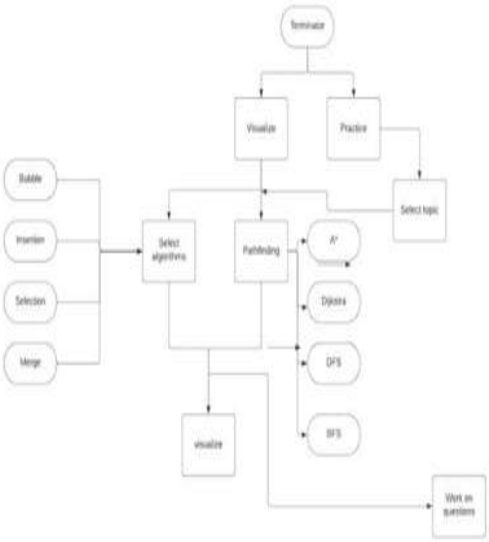
III EXISTING SYSTEM

In the existing system, algorithm visualization tools serve as pivotal resources in computer science education, offering interactive platforms that enable learners to explore, comprehend, and analyze complex algorithms. These tools typically feature interactive visualizations, step-by-step execution tracing, and user-friendly interfaces, facilitating active learning and experimentation with algorithmic concepts. Widely used platforms such as VisuAlgo and Algorithm Visualizations by David Galles provide comprehensive coverage of algorithms and data structures, accompanied by educational materials and tutorials. While existing systems offer valuable resources for learners and educators, they also present limitations, including varying levels of coverage, interactivity, and customization options. Therefore, there is a continuous need for research and development to enhance existing systems, address limitations, and explore new avenues for algorithm visualization in computer science education

IV PROPOSED SYSTEM

Here in the proposed system, the user can select whichever model or algorithm he/she wants to study. On its selection according to the algorithm, a graph or its visual representation will be generated. On starting the animation, a systematic and detailed animation will be shown so asto how the algorithm works for a better understanding. The animation speed can be controlled according to the user's pace. After learning, the user can also test their knowledge by trying to predict the working before playing the animation.

V METHODOLOGY



The implementation of algorithms in a visually appealing animated format is developed using the various available animation libraries in JavaScript. A user friendly and interactive website is created to which all the algorithm visualization models are exported. A backend database connectivity is also given to the system to keep a record of the existing users and new ones along with providing them the feature of tracking their progress in their respective accounts. Some of the general animation controls implemented in the system are – Skip back/forward, Step back/forward, Play/Pause, Change canvas size.

VI EXPERIMENTAL AND RESULT

A) Test Case 1:

The Proposed System was tested to verify the user authentication process and access to the Home screen. The system was accessed without prior authentication. The user attempted to navigate directly to the Home screen without any authentication process in place.

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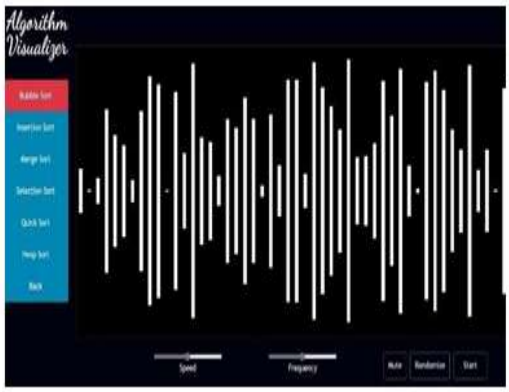
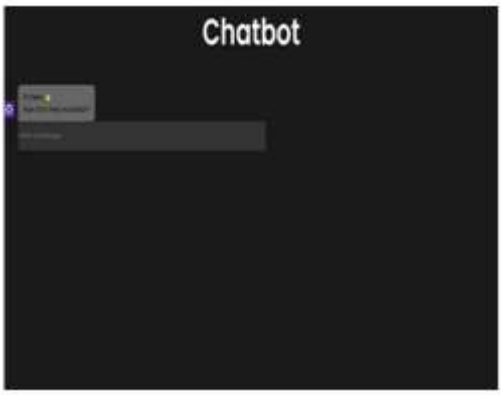
HOME PAGE

B) Test Case 2:

The user attempted to navigate to the algorithm visualization page and interact with the visualizations according to their preferences.



BUBBLE SORT



CHATBOT

CODE EDITOR

VII CONCLUSION

Some features implemented include a feedback system enabling the user to contact us if there exist any queries or even suggestions. While learning from the visualizations the learner can input their own data and see the outcome animated. So, they can experiment with various self- generated examples. They can also control the animation speed along with the options of rewinding, fast forwarding or skipping a particular iteration. Some ofthe general animation controls implemented in the system are - Skip Back/Forward, Step back/forward, Play/Pause Toggle, Animation Speed (in the form of slider) & Change Canvas Size (to change the width / height of the display area).

VIII FUTURE WORK

A visualization tool for visualizing some basic geometric algorithms along with data structure algorithms and operations associated with them has been presented. This tool provides an easy way to play and learn data structure concepts with its user-friendly and self-explanatory interface. In this system, only some commonly used and basic algorithms are implemented like arrays, queues, stacks, linked lists, linear and binary search tree, various sorting methods etc. Its scope can be extended by implementing more complex algorithms in the software. It can also be categorized for a more systematic interface. Developing and implementing a mechanism for the software package to recognize the user- defined observable data structures, and leave the implementation to the user is yet another way to extend its current scope, allowing users to use their own observable data structures, thus adding more flexibility to the software.

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