International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 03 | March - 2023 Impact Factor: 7.185 ISSN: 2582-3930

ALGORITHM VISUALIZER

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Abstract: Everybody has a different way of learning new information, this is called your learning style. Our learning style is how we best learn information. One of the most popular learning styles of 21st century is visual learning. "Algorithm Visualizer" is an online visual learning tool which acts as a catalyst in learning complex computer science algorithms. It provides an interactive experience for a learner to visualize the end-to-end implementation of an algorithm. The application contributes in solving the burden of learning two of the most popularly known algorithms, searching and sorting.

Key Words: Algorithm visualizer, Sorting, Searching, Algorithm.

1. INTRODUCTION

Algorithm Visualizer has a long history in Computer Science education, dating from the 1981 video "Sorting out Sorting" (Baecker & Sherman, 1981) and the BALSA system (Brown & Sedgewick, 1985). Since then, hundreds of AVs have been implemented and provided free to educators, and hundreds of papers have been written about them (AlgoViz.org Bibliography, 2011). Good AVs bring algorithms to life by graphically representing their various states and animating the transitions between those states [1]. Computer science core instruction attempts to provide a detailed understanding of dynamic processes such as the working of an algorithm or the flow of information between computing entities. Such dynamic processes are not well explained by static media such as text and images, and are difficult to convey in lecture [1].

Visualization of algorithms contribute to improving computer science education. The process of teaching and learning of algorithms is often complex and hard to understand problem. Visualization is a useful technique for learning in any computer science course [3]. For example, when I was learning about sorting algorithms while pursuing my Computer Science degree, I found that seeing the data move to its correct position under the constraints of an algorithm was much easier to follow than tracing the code by hand. That led to the inspiration of this paper, which describes a web-based tool we created that animates how sorting and searching algorithms modify and organize a set of data [4].

2. LITERATURE SURVEY

A. Motivation

The main goal is to help learners understand the intricacies of algorithm and data structure implementations. These graphical and animation tools provide a step-by-step walkthrough of how operations are performed on the data structures and algorithms. Most of these tools cover relatively complex but essential concepts for the novice students. As an eLearning tool it has a substantial potential to deliver efficacious instruction and improve students' learning outcomes [5].

B. Relevance of work

Over the past decades, a number of Algorithm Visualization tools have been developed and it is still receiving increased interest from students and educators. As browser is becoming the universal interface to a range of applications, web-based learning environments have a growing impact on education and learning [2]. Recent surveys on AV tools development can be found in [1] and [2]. Most AV systems provided promising results with their potentials in demonstrating the algorithm and data structure step by step in animation in terms of changing values in the variables [2].

In 2014, paper "Design and evaluation of a web-based dynamic algorithm visualization environment for novices" author presents DAVE, a web-based dynamic algorithm visualization environment designed to support secondary education students' learning about basic algorithms.

In 2015, paper "E-learning Tool for Visualization of Shortest Paths Algorithms", The preliminary test results provide evidence of the usability of the e-learning tool and its potential to support students' development of efficient mental models.

In 2017, paper "Visualizing Sorting Algorithms", This paper discusses a study performed on animating sorting algorithms as a learning aid for classroom instruction. A web-based animation tool was created to visualize four common sorting algorithms.

In 2018, paper "Towards Developing an Effective Algorithm Visualization Tool for Online Learning" it reports a work-in-progress research project at Athabasca University on developing an effective algorithm visualization tool for online learning.

In 2019, paper "Open Interactive Algorithm Visualization", The author presents a work-in-progress project for developing an open interactive algorithm visualization website.

The above citations and ongoing growth of the algorithm visualization tool sums up the impact and usefulness of the tool being relevant to a learner in the field of computer science.

3. PROPOSED SYSTEM

A. System Architecture

The project contains 3 pages :-

1. Home page
2. Sorting Algorithm
3. Searching Algorithm

The project includes visualization of sorting and searching algorithms. The interface is build using HTML5 and CSS, HTML5 for the structure of the webpage and CSS for the designing part. The logic of algorithms and animation are implemented via JavaScript. All three are interconnected and work in sync with each other as a trilogy and results in an interactive tool for learners.

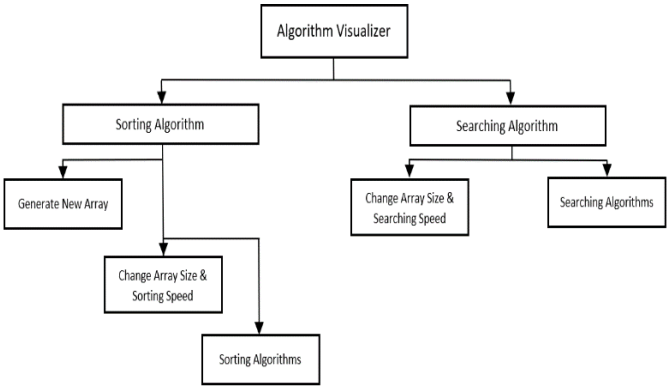

Figure 1: Architectural Design of Algorithm Visualizer

B. Workflow

User can visit two different pages form the home page :-

1. Sorting Visualizer
2. Searching Visualizer

1. Sorting algorithms

The navbar of the sorting algorithm consists of the following options :-

a) Generate new array
This function generates a random array each time when its being called. The array is represented through vertical bars. Height of each bar is proportionate to the value of each element.

b) Change array size & sorting speed
These functions implement the changes in array size and the speed of execution for the selected algorithm.

c) Sorting algorithms
- Insertion Sort
- Selection sort
- Bubble sort
- Merge sort
- Quick sort

Designing
For proper visualization we have used different colors to differentiate between the sorted bars and unsorted bars and even for bars which are currently in the process of comparison and sorting.

2. Searching algorithms

The navbar of the searching algorithm consists of the following options :-

a) Change array size & searching speed
These functions could be used to change the size of search space and the speed of execution for the selected algorithm.

b) Searching algorithms
- Linear search
- Binary search

Once the user selects the desired algorithm, he/she can enter the value in the search box as input and press the search button to execute the process. The reset button could be used to generate a new random array

Designing
The array elements are represented in small square shape cells with its numeric value and index number.

C. Data Flow Diagram:

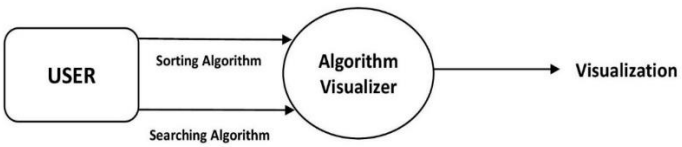

Figure 2: Data Flow Diagram

In Data Flow Diagram rectangle presents External entity (an outside system that sends or receives data) and circle show a Process (process that changes the data, producing an output). The arrows towards the process shows input while the arrows away from the process shows output.

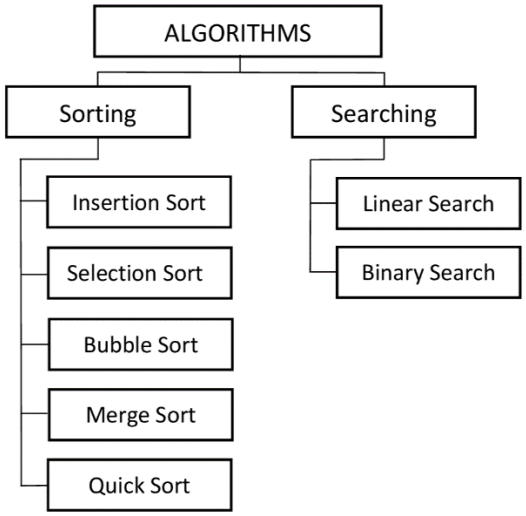

Figure 3: Algorithms in proposed system

The proposed system contains two types of algorithms

1. Sorting algorithms
2. Searching algorithms

Sorting Algorithms:

The sorting algorithm will rearrange the array of numbers in ascending order by executing the selected algorithm, comparative to the values in the array.

Searching Algorithms:

The searching algorithm will search the numeric value given by the user as input. for linear search the array will have a random sequence and for binary search the array will have a sorted sequence.

4. CONCLUSION

In this digital era the forms of visual learning will have quite an edge over the native learning techniques. After studying various literatures throughout our research over the following topic we can clearly observe the immense popularity of visualization learning mechanisms for algorithmic visualization, they are in demand for more than four decades. The algorithmic core principle remained quite similar throughout these years, but the implementation of GUI scales up to a better and much interactive version with the introduction of emerging languages and methodologies over time. Our implementation is also a way forward in same direction. The Application developed will not only benefit the learners but can also be used for teaching and research purposes.

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