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Human Computer Interaction in Education

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Abstract*: Human-Computer Interaction (HCI) is no longer the sole study of information technology or computer science but now it has covered the area of medical, entertainment, etc. As the application of HCI is increasing, so is the requirement of students to work in a multidisciplinary environment. Making students comfortable working in a multidisciplinary environment is not an easy task. The students are required to make pretty much aware and comfortable with the underlying problem statement. The evolution of HCI in education is to make sure that students can understand the concepts and working of the model in a more effective way. The goal of this project is to create a web-based e-Learning tool, 'Path Finding Visualizer'. It refers to computing an optimal route between the specified start node and goal nodes visualizing shortest path algorithms. The conceptual application of the project is illustrated by the implementation of algorithms like Dijkstra's, A*, and DFS. The end product is a web application so that any user can easily see and learn the working of the algorithms through perceivable visualizations. The user-friendliness of the project provides the user with easy instructions on how to operate it. The initial results of using the application show promised benefits of the e-Learning tool towards students getting a good understanding of shortest paths algorithms.

***Keywords*: Path Finding Visualizer, Graph, Education, Data Structures**

I. INTRODUCTION

The system of bringing forward new ideas with the help of human knowledge is a way of science [1]. With the evolution of HCI in recent decades, it has been shown that there is a requirement of creating a more interactive layout to represent the theoretical aspects [2]. For HCI, to enhance the pedagogical discipline, it is essential to have a system that could handle the past along with the current scenario in trouble solving manner. This result provides a way of question answering as per the user demand and helps us out in providing the outputs as per the desire.

The area has dragged a lot of involvement from the researchers. The embedding innovative idea of education into the traditional education system is quite difficult. Bannon [3] has argued that the education systems are required to be changed to synchronize with technology. However many studies have proved its merits. The paper presents a tool that can help students to learn the basic concepts of algorithms which a high probability of know-how the algorithm has actually worked. The basic idea behind the project is to make students clear and aware of the working of algorithms so that they can compare them and can use them for future perspective.

The paper is structured in the following sections: in section II literature review is presented, followed by the methodology, results, and conclusion of the present work in the following sections.

II. LITERATURE REVIEW

The paper initially introduces the Multimodal Interaction System, including its design and operating mechanism, as well as practical applications [4]. Apart from standard technology devices such as keyboard, mouse, and screen touching, the latest voice and face expression recognition technology can be employed for data input. The standard screen display, as well as the most up-to-date voice, faces expression synthesis, and gesture generating, can be employed for output. This review paper discusses a number of various major research topics in the field of human-computer interaction in the context of e-commerce and education [5][6]. It identifies some of the difficulties users have when exploring Web sites and doing information searches, as well as various study areas for improving navigation and search. It also examines the importance of emotional intelligence in the realm of human-computer interaction [7], where the initial answer is to recognize the Basic Emotions utilizing cultural commonalities for easy differentiation [8]. Once you've gotten over the basic emotional, cultural, and individual differences, you'll run into design challenges and opportunities.

It looks at how the design process, which is a crucial aspect of HCI work, has been conceived of and applied in the area of education. This paper explores the issue of theory and how various theoretical stances affect the creation of educational technology. In the existing system, it is difficult to understand the different algorithms proposed in design analysis and the algorithm's subject because there was no visual representation of the algorithms. Precise investigation of the cumbersome information present was not completely absorbable for better grasping of the algorithms.

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It emphasized how viewpoints in HCI reflect these contrasts as well, ranging from studies that look at how people interpret and respond to interface changes on screens to studies that look at societal concerns related to the use of technology in various situations. The paper makes the case that integrating design processes with pertinent learning theories can lead to more complex designs of learning technologies [6].

III. METHODOLOGY

The path finder finds the shortest path between two points, this project visualizes numerous path finding algorithms [10]. The algorithms are designed in a way to be visualized in 2D grid, the user has the control to select the algorithm to be visualized and draw walls as obstacles within the grid. When the visualization is finished the path from the start to end node is highlighted in yellow color [11].

A. Picking An Algorithm

The project involves numerous pathfinding algorithms some of them are weighted and some are unweighted and all the algorithms doesn't guarantee the shortest path. The user can select the algorithms which he/she has to visualize and after clicking the visualize button all other buttons will be freezed and will be freezed when the visualization will end[9].

B. Algorithm Description

The project involves 4 algorithms, BFS (Breadth First Search) Algorithm, DFS (Depth First Search) Algorithm, A* Algorithm, Dijkstra's Algorithm.

a. Breadth First Search Algorithm

Breadth First Search is a graph traversal algorithm in a data structure that works on the principle of traversing the graph which here is in form of a 2D grid and explores all the neighboring nodes after that it selects the nearest neighbor and explores all unexplored neighbors. Breadth First Search uses a queue to store unexplored nodes and puts every vertex in two categories: visited and not-visited. Breadth First Search guarantees the shortest path [14].

b. Depth First Search Algorithm

Depth First Search is a recursive graph traversal algorithm for traversing the vertices of the graph. Since it is a recursive algorithm it starts with a root node and goes deeper and deeper until it finds the goal node or the node with no children. However, it does not ensure the shortest path [15].

c. Dijkastra's Algorithm

The Dijkstra algorithm is one of the prominent algorithms to find the shortest path from the source node to a destination node. It uses the greedy approach to find the shortest path. The concept of the Dijkstra algorithm is to find the shortest distance (path) starting from the source point and to ignore the longer distances while doing an update [13].

d. A Algorithm*

A-Star is the most common technique that is used to find the shortest path in a real-life situation. A-star is simple and efficient algorithm. A-star uses a heuristic function and cost that provides some additional information regarding how far we are from the goal node [12].

C. Adding Walls

Users can click on the grid anywhere to create a single wall or can drag through the grid wherever he/she want to create walls. Walls act as obstacles that are not penetrable that give a more clear understanding of the algorithms.

D. Description of the Algorithms

On the right sidebar, the description about all the algorithms are mentioned in the accordion, so that user's can also read about the working of the algorithm.

IV. SYSTEM IMPLEMENTATION

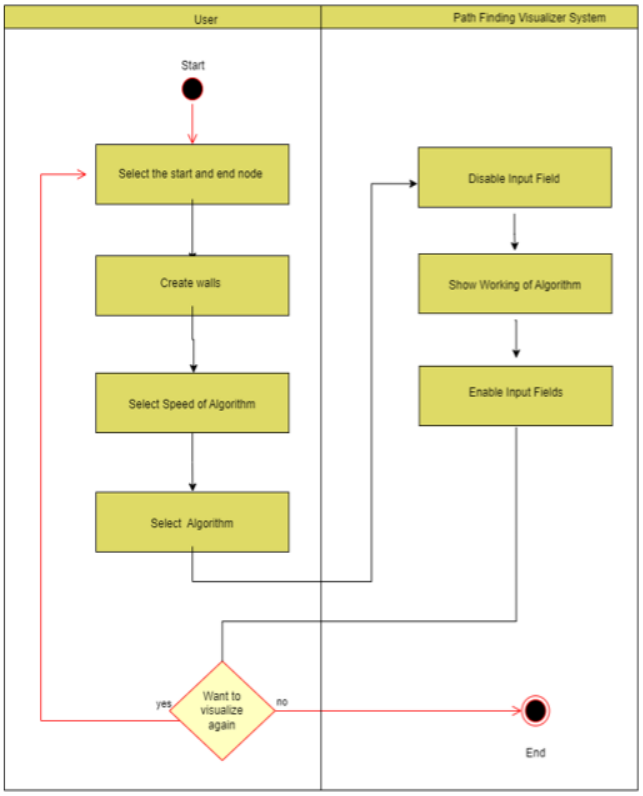

Figure 1. Flowchart of algorithm flow

The proposed system is built on React Js, a javascript framework created to visualize various path-finding algorithms, there were seven phases of the implementation. The first phase was building the 2D graph grid. The project has a 'Path Finding Visualizer' component and for the creation of the 2D grid HTML table component is used where a bunch of nodes was used and iterated through all the rows and columns and the start point is highlighted with green color and the finish point is highlighted with the red color. The second phase was to add walls and event listeners there are three mouse listeners, 'handle mouse down()', 'handle mouse enter()', 'handle mouse release()' added to create walls because users don't want to click again and again to create walls the user would just drag the mouse over the grid and click and release the mouse button to create walls and the grid with the walls will not be visited by the algorithms. The next phase was animating the nodes. When the user clicks on the visualize button the function for the particular algorithm is called and it keeps track of all the visited nodes in an array after a few milliseconds the state will be updated with dark blue color and when the goal node is reached the distance is marked with the yellow color.

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The next phase was including some other functionality such as clear walls and a clear grid. When the clear grid event is called except for the start node, goal node, and walls it clears the total path and empties the arrays, and resets all the other states to default. When the clear Walls function is called it removes all the walls by iterating through the grid and all the classes with the name 'wall-node' are disabled. The next phase was adding the accordion where all the description of the algorithm is written for the accordion there is separate component is created named 'accordion' which comprises of an accordion list, accordion body, and accordion data.

V. RESULTS

The aim to visualize the path from the source node to the destination node has been efficiently visualized using various kinds of calculations.

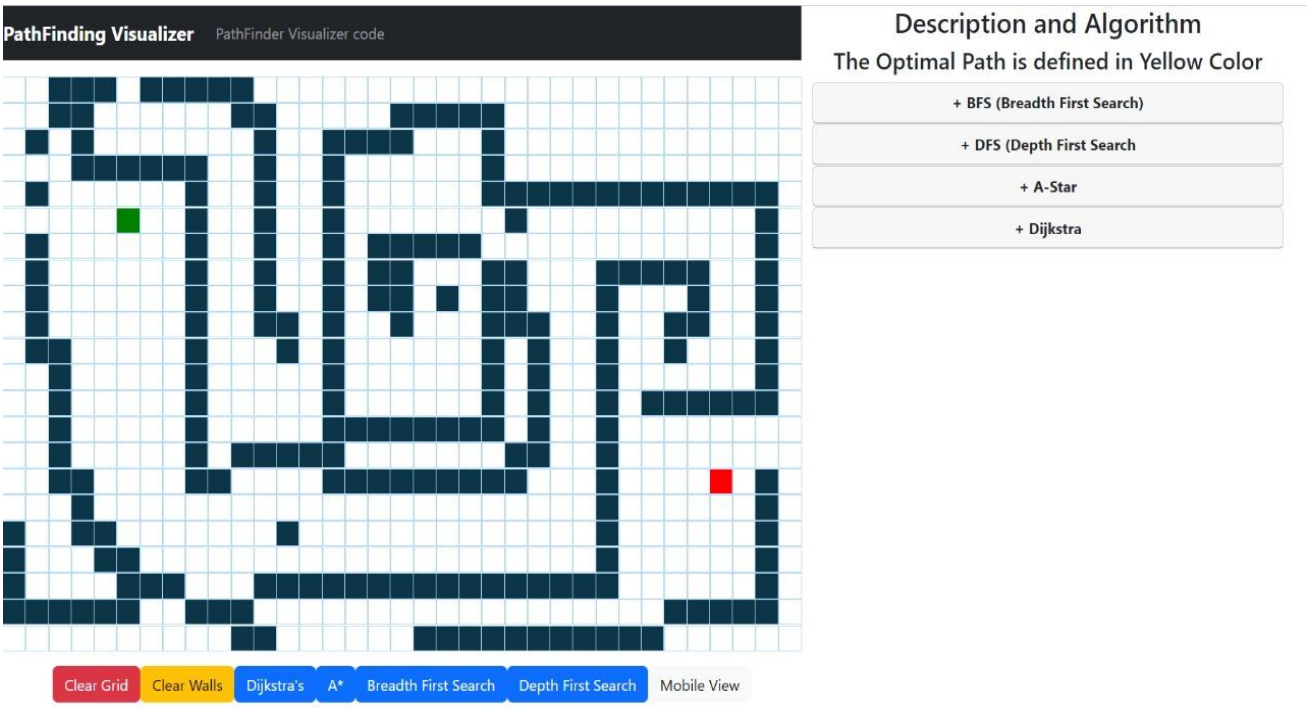

Figure 2. Insert Random walls in grid

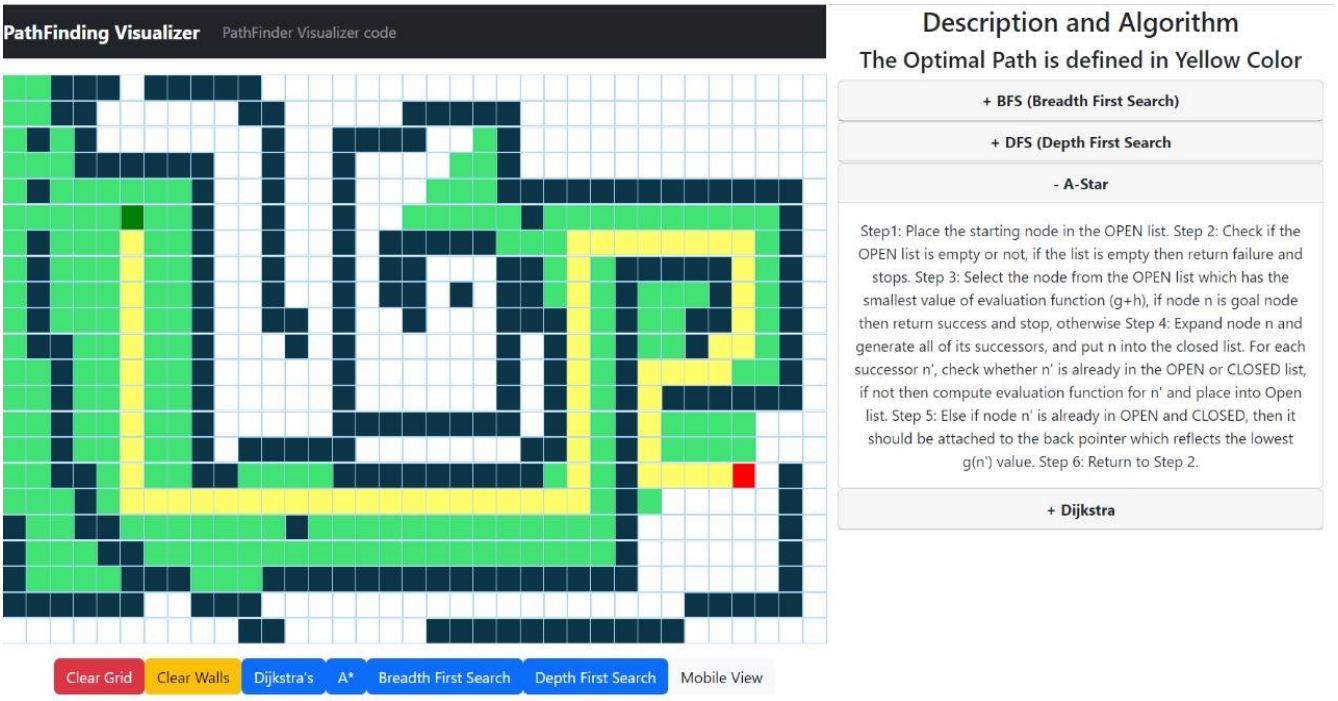

Figure 3. Path Found by A* algorithm

VI. FUTURE WORKS

The refinement of the project which will enhance and intricate better educational practices in effective ways are:

- Improving the UI of the website.
- Adding more algorithms for visualization Adding more features such as weighted walls

VII. CONCLUSION

With the consummation of the project, the assignment of Visualizing Path Finding was fully accomplished. The captious loophole between the hypothesis and functional comprehension in various shown regions has refined calculation acknowledgments. The primary objective of the framework is to reconcile the informatory climate and understudies to work with tutoring expertise in a skilled manner.

DECLARATION

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