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Critical Analysis on Algorithm Visualization

Arshlaan Saifi, Dwitika Singh, Kanchan Tomar, Manali Mishra
Department of Information Technology, IIMT College of Engineering, Greater Noida, Uttar Pradesh, India

ABSTRACT

Over the years we’ve observed that algorithms even tough being acomplex subject are the foundation of computational thinking andprogrammingskillsofastudent.So to ease up the hardships of students this idea of the project wasformed. Our application Algorithm Visualizer is both interactive andalluringtostudents.Itgivesthestudentshandsonexperienceofthealgorithms’ implementation. It feeds into their imagination to helpthem get a better understanding while also helping teachers to helpmaketheirstudents understandbetter.Through this project every student can learn at their own pace withour three speeds of learning: slow, average and fast. This interface isdesignedtomakeonefeelfullyengagedandconcentrated.Theconcept of Time Complexity has also been introduced to the userthroughaninteractivegame.Wehavemade useofReact.jsasframeworkandJavaScriptasprimarylanguageforourproject.Thepurposeofthisprojectistomakelearning less of a burden and more of an incredible experience whichleavesstudy.

Keywords: different searching, sorting algorithms, visualizations, algorithm's operations.

I. INTRODUCTION

keep When we talk about complex subject topics like Algorithms, itbecome necessary for students to have a strong grip over the topic asit would form the foundation of their computational thinking andprogrammingskills. We have observed that through conventional methods of teaching itbecomes a little difficult for students to understand the concept and for teachers to explain their thoughts. Motivated by the age-oldsaying,"apicturespeaksmorethanthousandwords",manyresearchersandeducatorsassumethatstudentswould learnanalgorithm faster and more thoroughly using algorithm visualizationtechniques. So, we developed a method of learning through visualization andhand-on experience over different searching and sorting algorithmswhich is bound to help the students and teachers. Good visualizationsbringalgorithmstolifebygraphicallyrepresentingtheirvariousstatesandanimatingthetransitionsbetweenthosestates,especiallydynamic algorithm visualization which shows a continuous, movielikepresentation of an algorithm's operations. Visualization allows thehumanvisualsystemtoextendhumanintellect;wecan useittobetterunderstand these important conceptual processes, other things, too.Also,weknowthemorewedothingsourselves and engage the more we tend to learn about a particulartopic.

Thus,engaginginvariousgamelikeactivitiescansurelyhelptheusers get aholdonthetopics.

II. METHODOLOGY

Architectural Design Our project comprises of 3 pages
1. Welcomepage
2. Path finding Algorithm
3. SortingAlgorithm

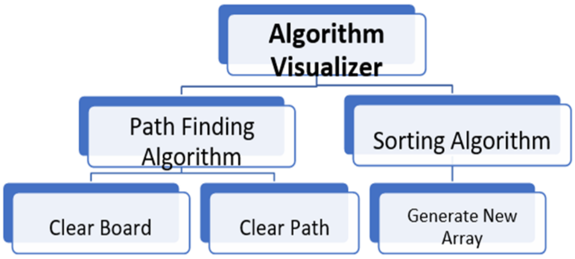


Figure:1 flowchartrepresentstheoverallarchitectureofourapplication

welcomepage:
1. Path-finding Algorithm
2. SortingAlgorithm

Path-findingAlgorithm

Thenavbarofpath-findingalgorithmconsistsofthefollowingoptions:-

Algorithms Wehaveincluded:

a) Dijkstra'sAlgorithmA*SearchGreedyBest-FirstSearchSwarmAlgorithmDepthFirstSearchBreadthFirstSearchThealgorithmspresent in the navbar are chosen on the basis of their popularity anddifficultylevel.Studentsfinditdifficulttounderstandthesealgorithmstheoretically. When they will see the visualization of these algorithmsthen they will be able to understand it better. User will be able todifferentiatebetweenthefunctionalitiesofdifferentalgorithmsonthebasis of timecomplexityafterthevisualizationisover.

b) Mazes and Patterns Maze and patterns are included to ensurebetter and clear understanding of algorithms. As there will be walls orobstruction between the starting node and the goal node, user canrelate the visualization with real world like situation. Also, user will beable to figure out which algorithm is better based on algorithm timecomplexity.Especiallyforuserslookingforaplayfuloptionforunderstanding these complex topicsthese fun filled options can turnouttobetheappropriateway.

c) Speed The project contains speed bar for maintaining the speed ofvisualization, this feature is included because everyone has a differentlearning rate so the user can vary the speed of visualization accordingto his/her choice. Designing Grid structure will be used to representeach node. Computer generated starting and ending node willbedisplayedinitially.Usercanchangethepositionsofstartandendnodeaccording to his/her will. Structure of Mazes & pattern can also bechangedaccordingtouser'swill(i.e.,patternofadditionofnewwalls).

1) SortingAlgorithm

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

a) Generate new array It will generate a new random array. Everytimeweclickonthis tabit will generate newrandom array.Arrayelementswillbe displayedinthe formof barswiththe height ofeachbar proportional to the numerical value it is representing. Whilesorting different coloured bars would be used to represent thesorted, unsorted and currently sorting numerical values from thearrayofinputnumbers.

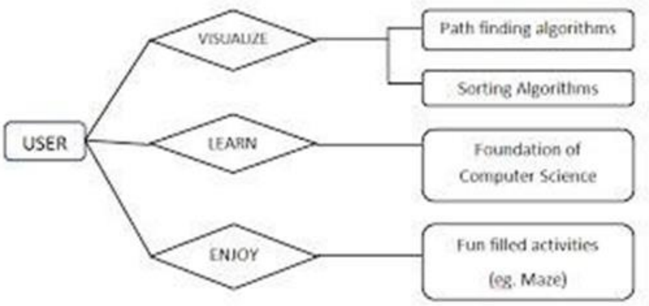
b) Change array size and sorting speed A slider will be provided sothat user can change the size of array and accordingly the speed ofsorting will vary. Size of array will be directly proportional to thesorting speed i.e. (larger the speed of array greater will be the speedof sorting). As, mentioned earlier this feature has been implementedto ensureusersare abletolearnattheirownpacewithout anyhaste.

c) Algorithms Merge SortQuickSort Heap SortBubbleSort

Usercanpickanyalgorithmfromtheabovelistofavailable algorithms. Algorithms are chosen on the basis of their popularity andimportanceaccordingtotheexistingcurriculum.DesigningForpropervisualization we have used different colours to differentiate betweenthesortedbarsandunsortedbarsandevenforbars whicharecurrently in the process of comparison and sorting. After sorting thecoloursofbarswillchangetosamecolourwhichwillbe differentfrominitialcoloursofarrayandarrayelementswillbearrangeinascendingorder.

III. MODELING AND ANALYSIS

Ourimplementationoftheprojectisbasedonthebelow ER (entityrelationship)modelAs we are able to see from the above model that the centre of attraction of ourapplicationistheuserthus,weneedtoensuregreatuser experience(UX)whichwould enhance the overall impact of our application. Since we did not havemuchcomplexrelationshipstomanageinourapplicationwedecidedtoimplementourappusingsomelightweightframeworksandscriptinglanguages.Thus,JavaScript as hebaselanguagewasanobviouschoiceowingtoitslightweightnatureandwidevarietyofframeworkoptions.Wethenwentthroughmostofthepopular JavaScriptframeworks .Wetestedeachofthemby trying to implement a sample page and came to a unanimous decision thatReact.js was the best choice due to its features like reusability, easy testing anddebugging, and component based approach. Now, the only thing left was todecide how to structure our application to maximize its effectiveness. For thiswe analysed a few existing designs over the internet and we finally decided onanarchitecture whichhasalreadybeenexplainedinthemethodologysection.



As we are able to see from the above model that the centre of attraction of ourapplicationistheuserthus,weneedtoensuregreatuser experience(UX)whichwould enhance the overall impact of our application. Since we did not havemuchcomplexrelationshipstomanageinourapplicationwedecidedtoimplementourappusingsomelightweightframeworksandscriptinglanguages.Thus, Java as the base language was an obvious choice owing to its lightweightnature and wide variety of framework options. We then went through most ofthepopularJavaframeworks.Wetestedeachofthem bytryingtoimplementasamplepageandcametoaunanimousdecisionthatForthisweanalysedafewexisting designs over the internet and we finally decided on an architecturewhichhas alreadybeenexplainedin themethodologysection.

IV. RESULTS AND DISCUSSION

Throughasurveyconductedbyusweinferredthat60%ofthestudentsresponded better to understanding concepts through visualization rather thantheir own imagination or the regular teaching methods. It's been proved timeand again through different experiments and research on masses that any kindof visual aid such as an image, a video or even an animation clip tends to berememberedmorebyhumans.

Not only will the visualization help but due to features of mazes and patterns inourapplication,thestudentscanrelatetheworkingofthealgorithmstoreallifeexamples (like obstructions in the form of walls). Often, we see teachersstruggling to make students understand concepts such as algorithms without itgettingmonotonous,that'swhereourprojectcomesinto playasagreatteaching aid. Because of our user-friendly and engaging interface, the problemofdistractionorlosinginteresttendstodecrease, makingitveryefficient.

Ourworkcaneasilybeincorporatedalongsideoureducationsystembypromotingdifferentwaysoflearningratherthantheage-oldblackboardmethodaswejustneedtoaccessawebsitehostedontheinternettousetheapplication.Andwithuncertaintimeslikenowadays,wecannotonlyaffordtobedependentonly on our teachers and one to one offline teaching to understand differentconcepts. E-learning is a new age learning technique, and our project is a steptowardsreinforcingthismethodoflearning.

V. CONCLUSION

In a nutshell, we identifies some issues by experiencing them ourselves in thepresent learning strategies in use and we tried to help better the scenario foraspiringstudents inthis domainthroughorprogressivewebapplication.When we ourselves were learning the subject of algorithms in our curriculum,wefounditabitdifficulttorelateandunderstandthepracticalimplementationofthealgorithmsowingtothedifficultyincommunicationoftheconceptsfromtheteacherstothestudents.Wefoundthattherewerenopropermeansthat the teachers could adopt to portray their ideas in a better and easy manner infrontofthestudents.So, we built an application which could help in the following ways:- It has beenfound that it becomes easier for humans to retain the concepts when learntthroughvisualsthanjusttextualorspeechexplanations.Applicationisextremely user friendly so people of any age can engage and start learning newthings rightaway.The application would also include various fun filled activities like visualizationthrough mazes and patterns. This application will also include a parameter oftime complexity which will be displayed after the particular sorting algorithmhas completedits executionforbettercomparison.Almostallthefamousandimportantalgorithmswillbepresentintheapplicationforvisualizationwithbothpath-findingandsortingalgorithmspresent in same application, thus making it a one stop destination for thestudents ofthisdomain.

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