# ABSTRACT

Given an unsorted array ‘A’ of integers and a target sum ‘T’, we need to determine whether or not there are two numbers ‘X’ and ’Y’ in A such that X+Y=T. The naïve solution to this problem could be to check every pair in the array, which is done in O(n$^2$).And a better solution could be to first sort the array and then search ,which takes O(nlog(n)).

This application is intended to show the GUI implementation of various solutions of the 2-sum problem and compare them by there time complexities. Using Hash Table the solution is refined to even better by just consuming only O(n) time to solve the problem.

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# 1. INTRODUCTION

## 1.1 Overview:

In computer science, a search data structure is any data structure that allows the efficient retrieval of specific items from a set of items, such as a specific record from a database.From linear search to binary search, we improved our search efficiency from O(n) to O(logn) . We now present a new data structure, called a hash table, that will increase our efficiency to O(1) , or constant time.

A hash table is made up of two parts: an array (the actual table where the data to be searched is stored) and a mapping function, known as a hash function. The hash function is a mapping from the input space to the integer space that defines the indices of the array. In other words, the hash function provides a way for assigning numbers to the input data such that the data can then be stored at the array index corresponding to the assigned number.

2-Sum Problem is a data structure problem, the solutions to this problem precisely demonstrates the evolution of these search techniques and the importance of the hash table.

This application also has an added advantage i.e TTS(Text to Speech) engine which gives a walkthrough along the application.

## 1.2Aim of the project:

The aim of this project is to create a very elegant user interface to show the implementation of various solutions of the 2-sum problem and compare them by there time complexities.

## 1.3 Organization of the report

The organization of the report is as follows:

**Chapter 1**: Deals with the Introduction of the project and gives the details about the project in an abstract view.

**Chapter 2**: Deals with software requirements and the specification

**Chapter 3**: Deals with the design and analysis of the project.

**Chapter 4**: Deals with the implementation of the project.

**Chapter 5:** deals with the results and screenshot.

**Chapter 6**: Deals with the conclusion and the future scope

**Chapter 7:** deals with the bibliography and references.

# 2. SOFTWARE REQUIREMENTS AND SPECIFICATIONS

## 2.1 Purpose:

The requirements specification is a technical specification of requirements for the software products. It is the first step in the requirements analysis process it lists the requirements of a particular software system including functional, performance and security requirements. The requirements also provide usage scenarios from a user, an operational and an administrative perspective. The purpose of software requirements specification is to provide a detailed overview of the software project, its parameters and goals. This describes the project target audience and its user interface, hardware and software requirements. It defines how the client, team and audience see the project and its functionality. i.e. it basically serves as an input to the design and coding phase of SDLC.

## 2.1 Functional Requirements:

- ➢ The application should define the problem.
- ➢ The application should ask the user for proper inputs.
- ➢ The application should show the constraints that were imposed on the inputs to be proper.

- The application should deny the access to further until unless the inputs were correctly validated.

## 2.2 Non-Functional Requirements:

- The application should not show any signs of glitches during transitions.
- The application should be stable and reliable.

## 2.3 Required Hardware:

### 2.3.1: Development

| | | |
|---|---|---|
| ➢ System | : | Pentium IV 2.4 GHz. |
| ➢ Hard Disk | : | 40 GB. |
| ➢ Floppy Drive | : | 1.44 Mb. |
| ➢ Monitor | : | 15 VGA Colour. |
| ➢ Ram | : | 512 MB |

### 2.3.1: Testing and execution

- OS: Windows 8.1
- NetBeans v8.0.1
- Photoshop CS6

# 3. ANALYSIS AND DESIGN

The analysis phase of any development project serves to identify and document the needs of the users. Proper analysis is critical to the success of all development projects as it clearly outlines the requirements for the development and helps to set the expectations of users. The work done during the analysis phase ensures that functionality is divided into critical components and optional.

***"Design is a funny word. Some people think design means how it looks. But of course, if you dig deeper, it's really how it works."***

The software NetBeans v8.0.1 has been used to implement our project. To clearly explain the design of this application, we present in three stages of development.

## 3.1 Stages

### 3.1.1 Stage I

The first stage of development deals with defining the problem statement and taking the required input from the user.

### 3.1.2 Stage II

The second stage deals with checking the inputs, these inputs are checked across various constraints and is given to further access only when all of them are validated properly.

### 3.1.3 Stage III

The third stage involves demonstration of various solutions of the problem. This stage is the most complex stage of all as it involves the stepwise animation to demonstrate. It is understood that more the complexity, more the enthusiasm to develop it. The in depth coding details will be explained in section 4.

## 3.2 Data Flow Diagrams

### 3.2.1 Level-0 DFD

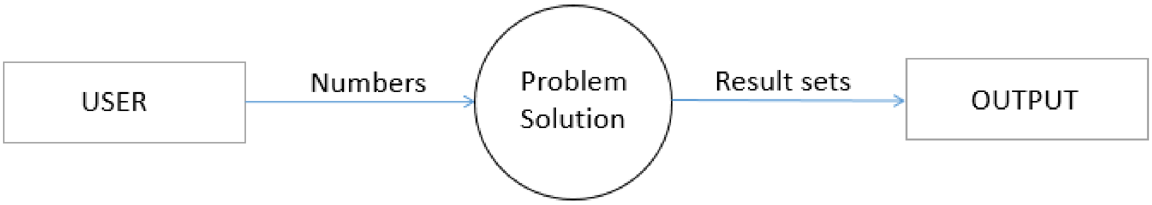


**Figure 3.2** Level-0 DFD

### 3.2.1 Level-1 DFD

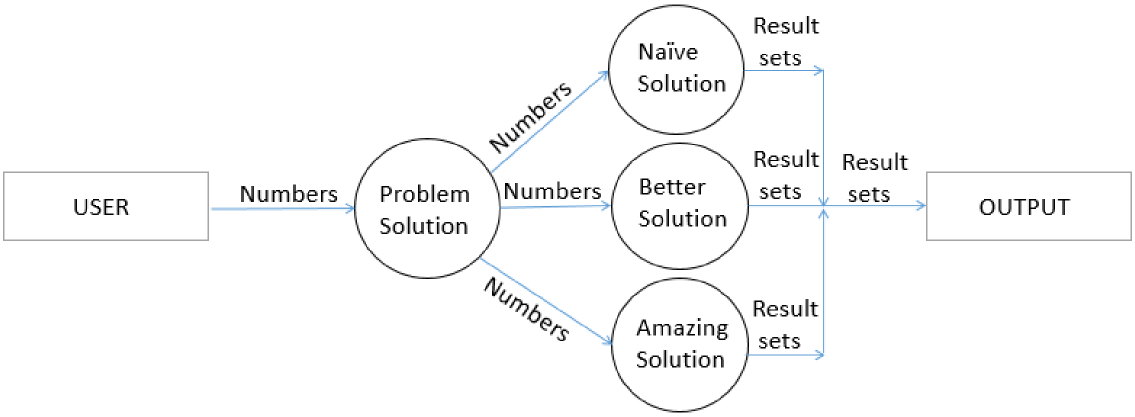


**Figure 3.2.1** Level-1 DFD

## 3.3 UML Diagrams

### 3.3.1 Use-Case Diagram

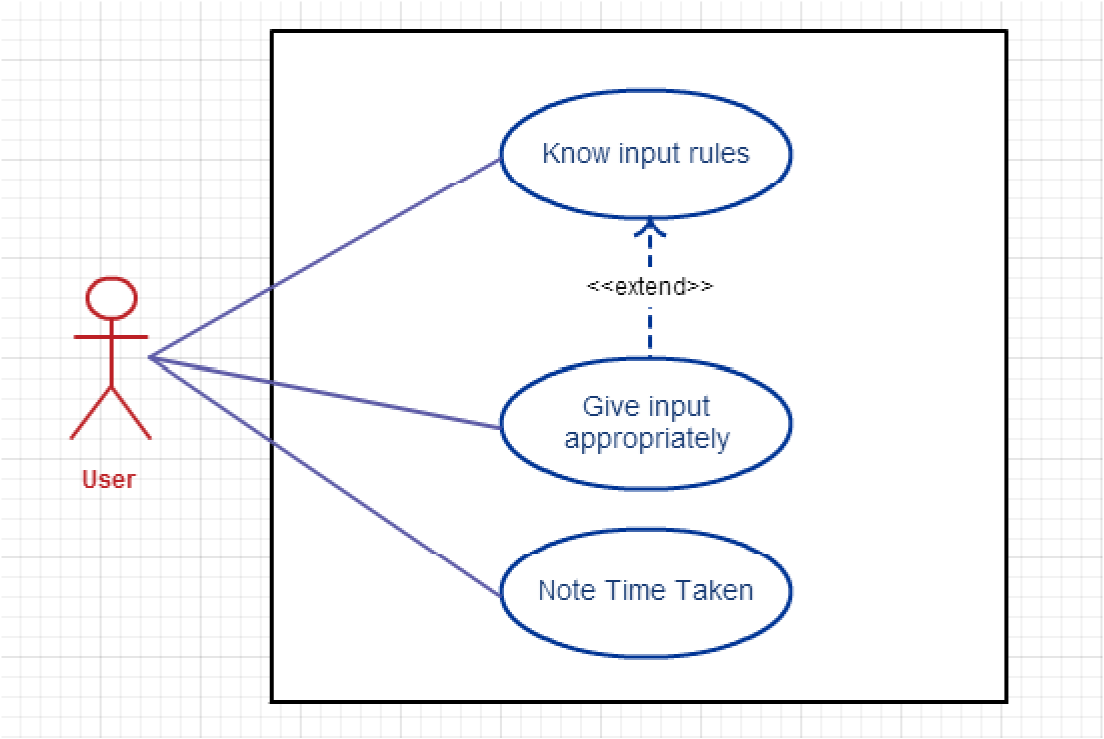


**Figure 3.3.1** Use-Case Diagram

### 3.3.2 Class Diagram

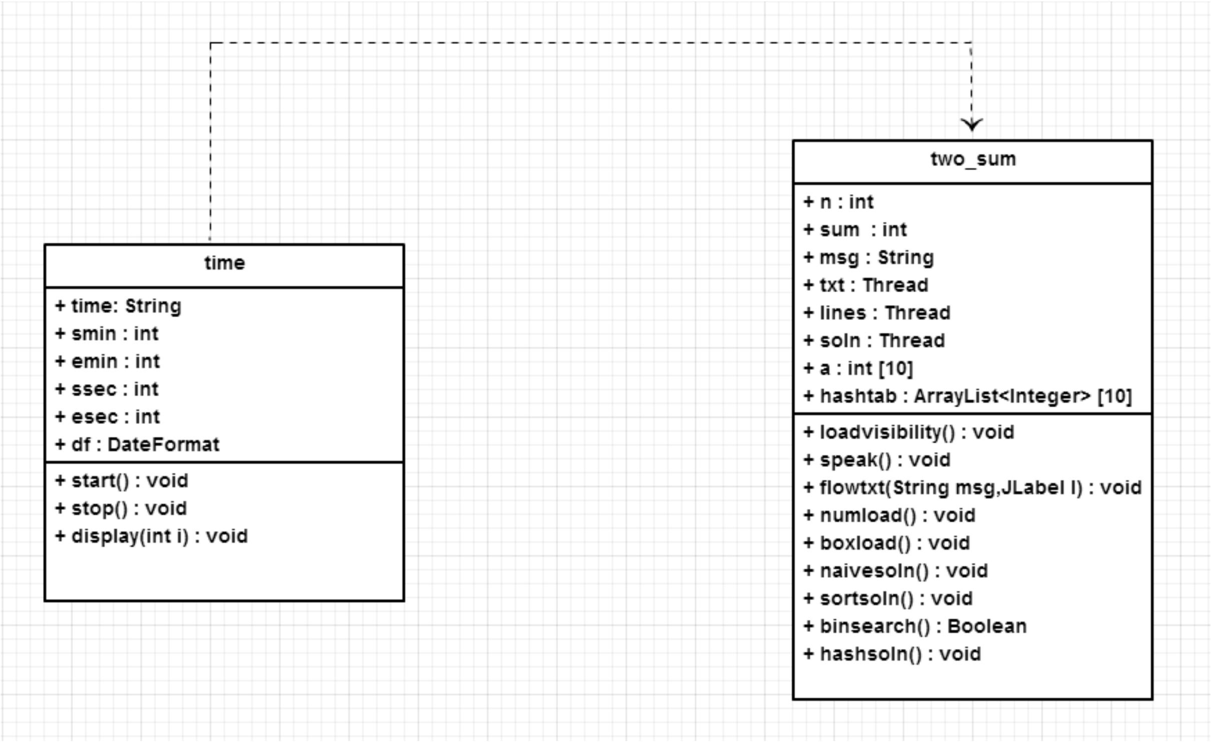


**Figure 3.3.2** Class Diagram

### 3.3.3 Activity Diagram

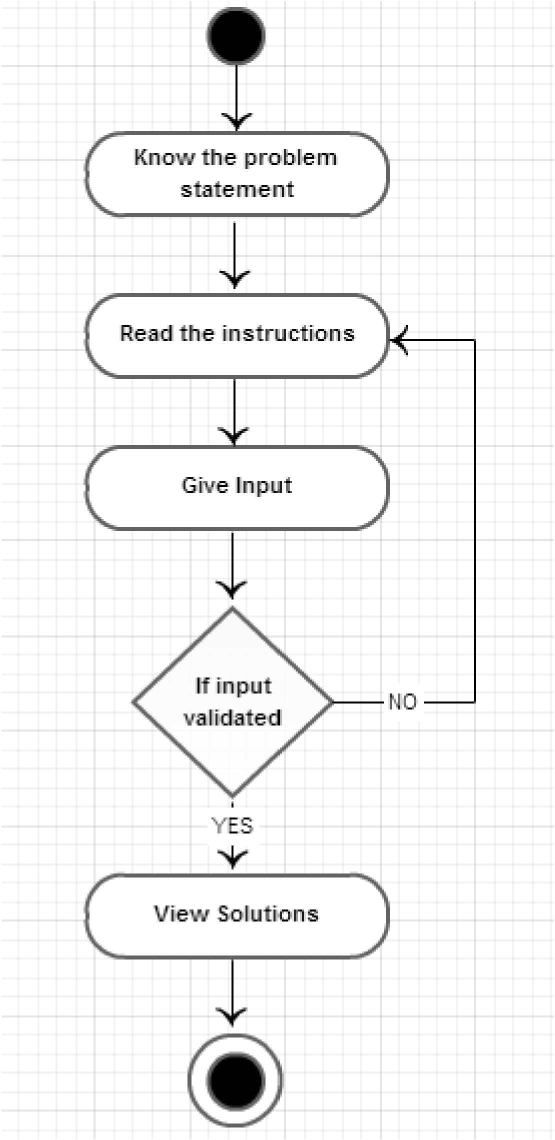
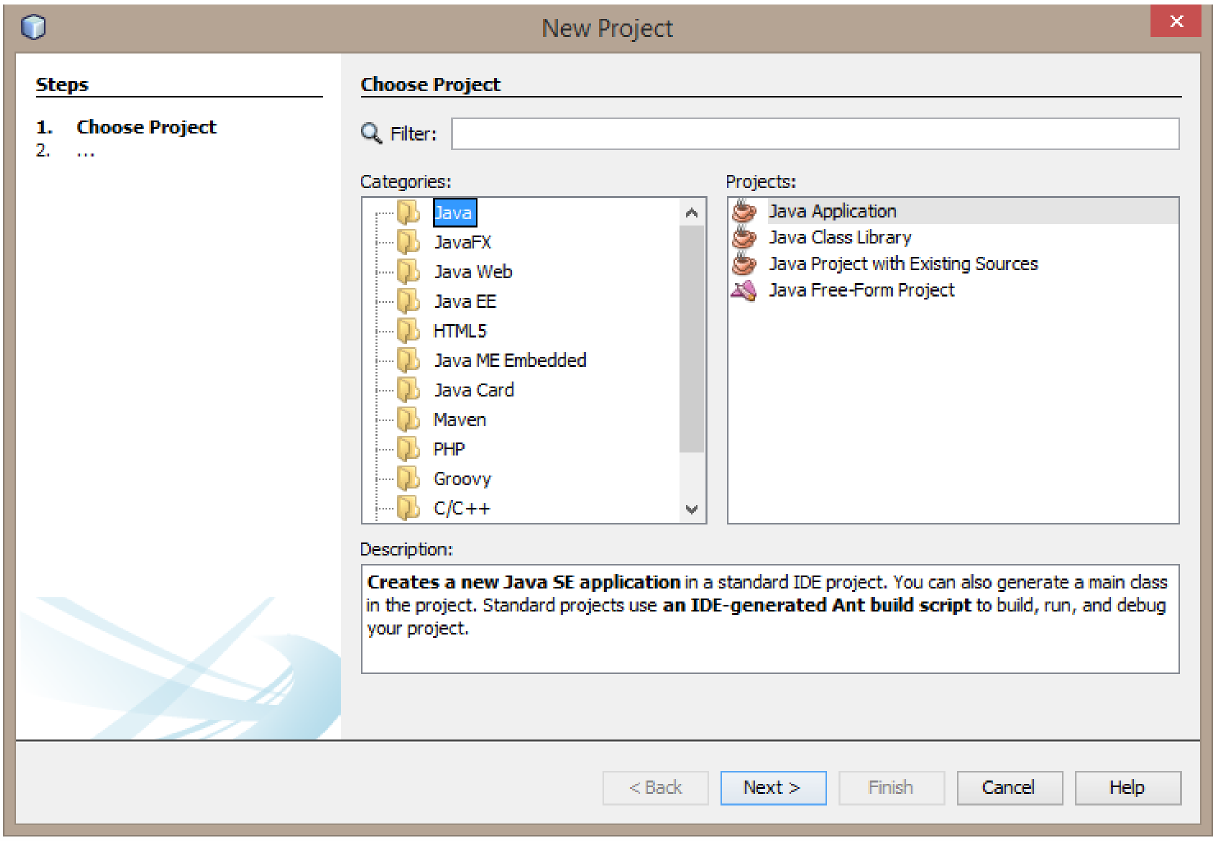


**Figure 3.3.3** Activity Diagram

# 4. IMPLEMENTATION

## 4.1 Creating java project

- Create a new java project in NetBeans. If you didn't have a project opened, NetBeans shows the Welcome screen. To create a new project, click New Project.
- If you had a project opened, Android Studio shows the development environment. To create a new project click File → New Project.
- This window lets you select the type of your project, Enter the values for your project and click **Next**.

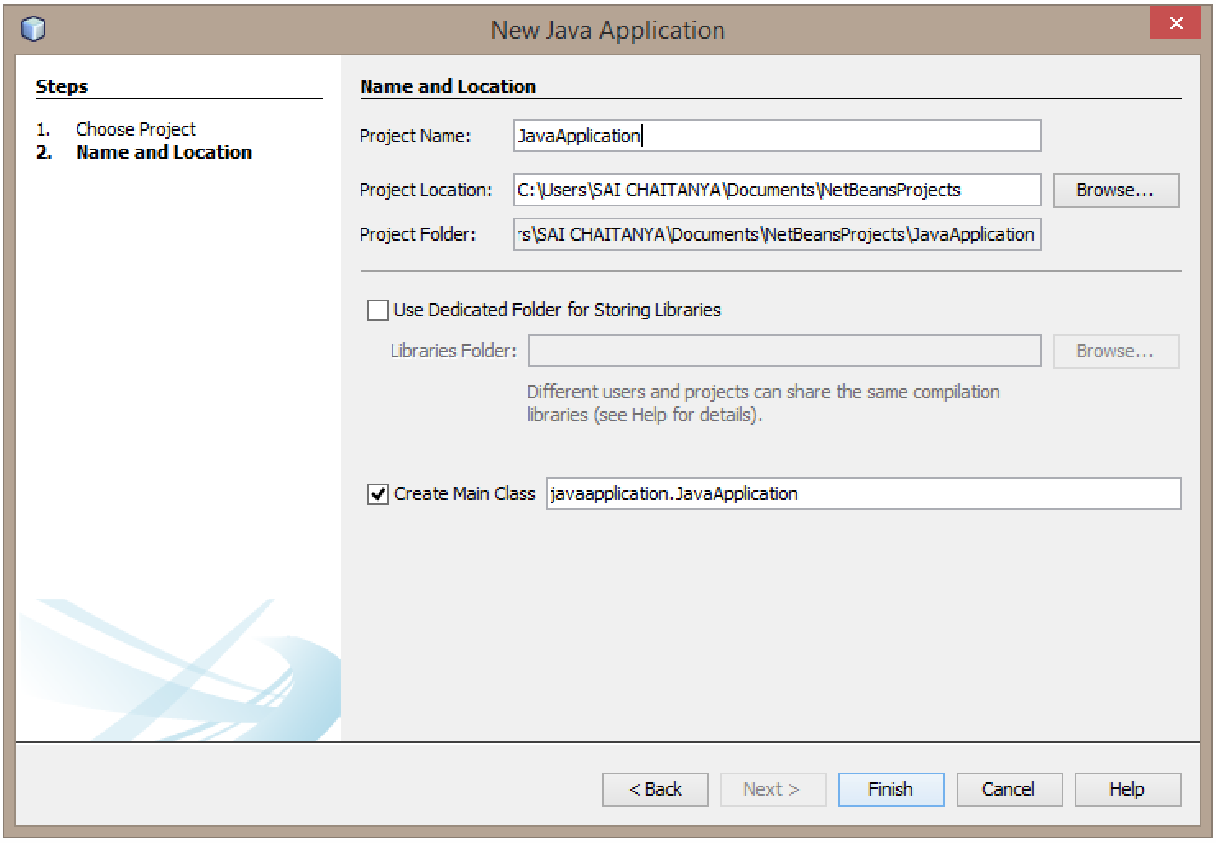


**Creates a new Java SE application** in a standard IDE project. You can also generate a main class in the project. Standard projects use **an IDE-generated Ant build script** to build, run, and debug your project.

**Figure 4.1** creating new project

## 4.2 Name & Location

The next window lets you configure the name of your application, the package name (should always be unique). and the location of your project.



New Java Application

Steps

1. Choose Project
2. **Name and Location**

**Name and Location**

Project Name: JavaApplication

Project Location: C:\Users\SAI CHAITANYA\Documents\NetBeansProjects

Project Folder: rs\SAI CHAITANYA\Documents\NetBeansProjects\JavaApplication

□ Use Dedicated Folder for Storing Libraries

Libraries Folder:

Different users and projects can share the same compilation libraries (see Help for details).

☑ Create Main Class javaapplication.JavaApplication

**Figure 4.2** Name and Location

## 4.3 Add a new JFrame

JFrame can be added by right clicking on the created project and selecting the new→Jframe form.

## 4.4 Project Files

The standard libraries folder gets imported to the project at the time of creation of the project,which include the jdk and other added .jar files like tts,mbrola etc.

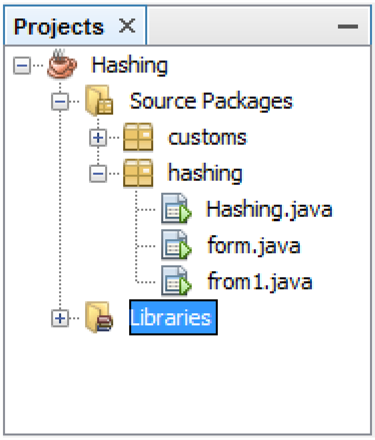


**Figure 4.4** Project file.

## 4.5 User Module

In this module an interface for the user to give inputs and to validate them against various constraints is done.

## 4.6 Design Module

In this module various components like frames, buttons for the UI are designed/modified in Photoshop CS6.

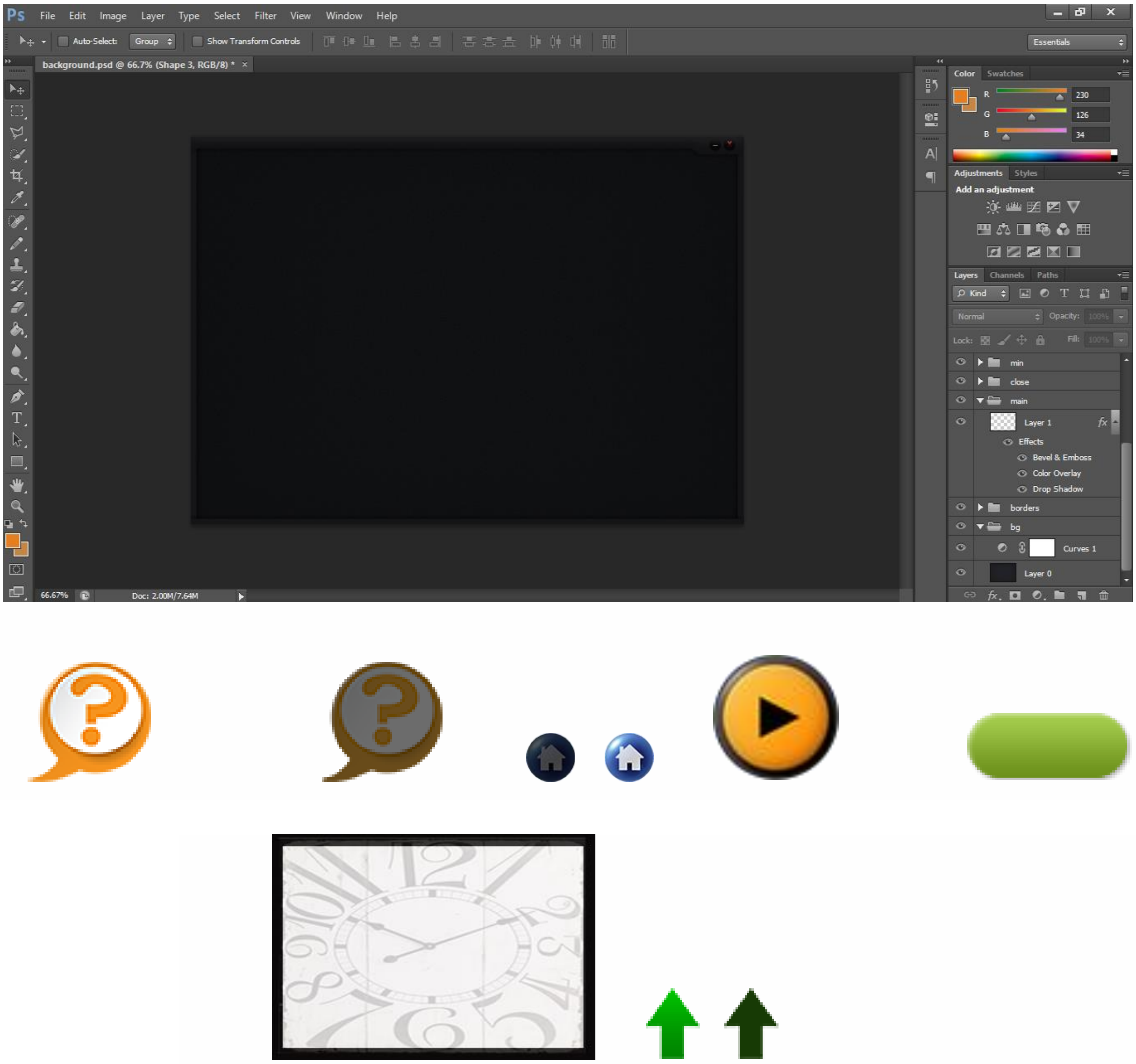


**Figure 4.5** designing in Photoshop

## 4.7 Display Module

In this module the solutions of 2-sum problem are to be displayed in a stepwise manner for the user given inputs. And time taken for each solution should also be displayed.

# 5. TESTING

## 5.1 Unit Testing

In computer programming, unit testing is a software testing method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures are tested to determine if they are fit for use.

## 5.2 Integration Testing

Integration testing (sometimes called integration and testing, abbreviated I&T) is the phase in software testing in which individual software modules are combined and tested as a group. It occurs after unit testing and before validation testing.

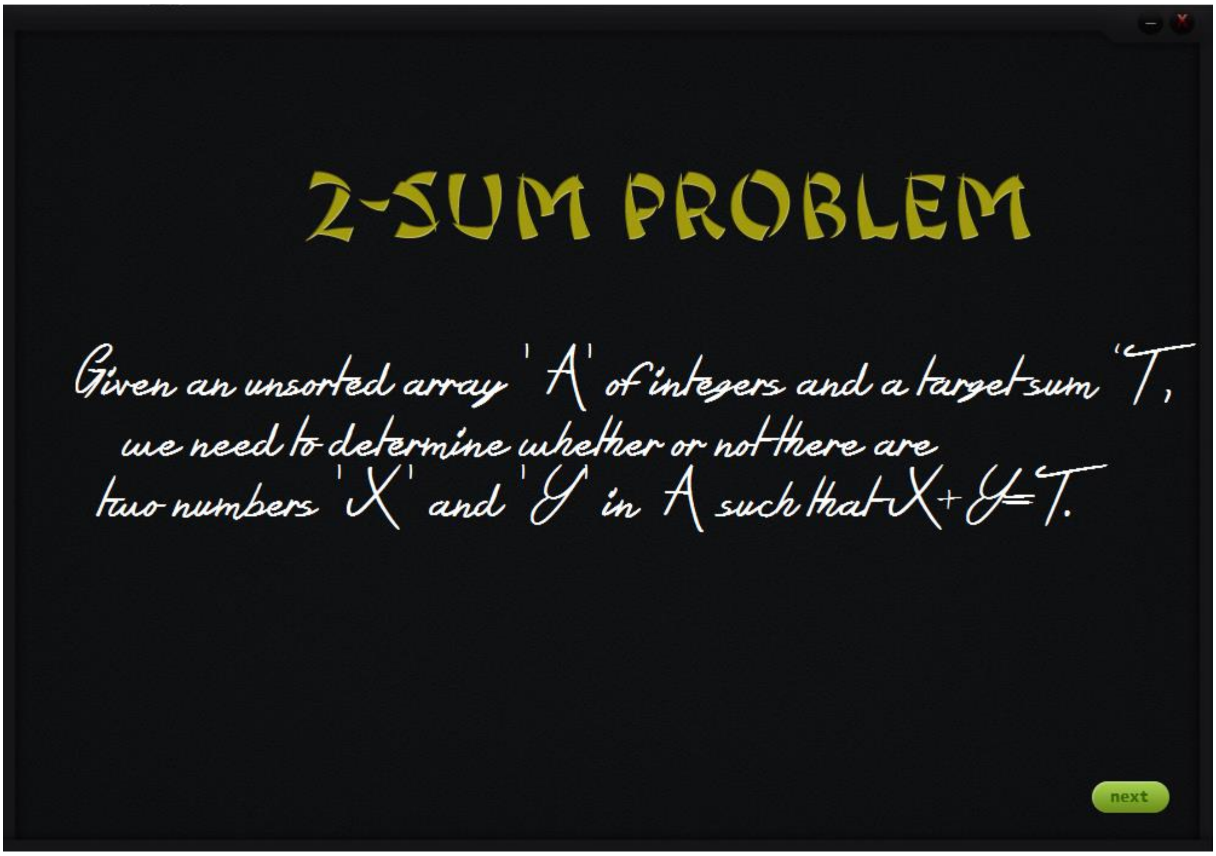
## 5.3 Black-Box Testing

Black-box testing is a method of software testing that examines the functionality of an application without peering into its internal structures or workings. This method of test can be applied to virtually every level of software testing: unit, integration, system and acceptance.

## 5.4 White-Box Testing

White-box testing (also known as clear box testing, glass box testing, transparent box testing, and structural testing) is a method of testingsoftware that tests internal structures or workings of an application, as opposed to its functionality (i.e. black-box testing).

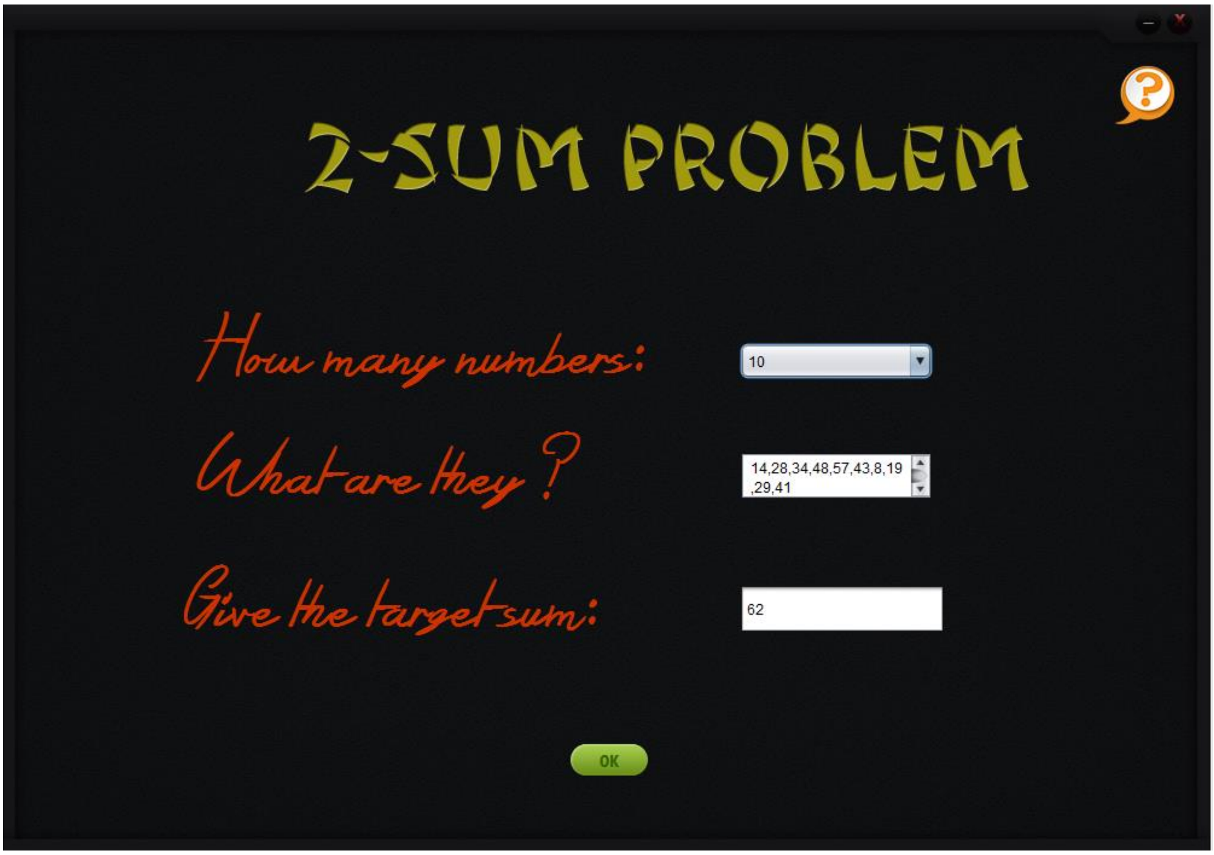
# 6. RESULT AND SCREENSHOTS



2-SUM PROBLEM

Given an unsorted array 'A' of integers and a target sum 'T', we need to determine whether or not there are two numbers 'X' and 'Y' in A such that X+Y=T.

**Figure 5.1** Problem Statement



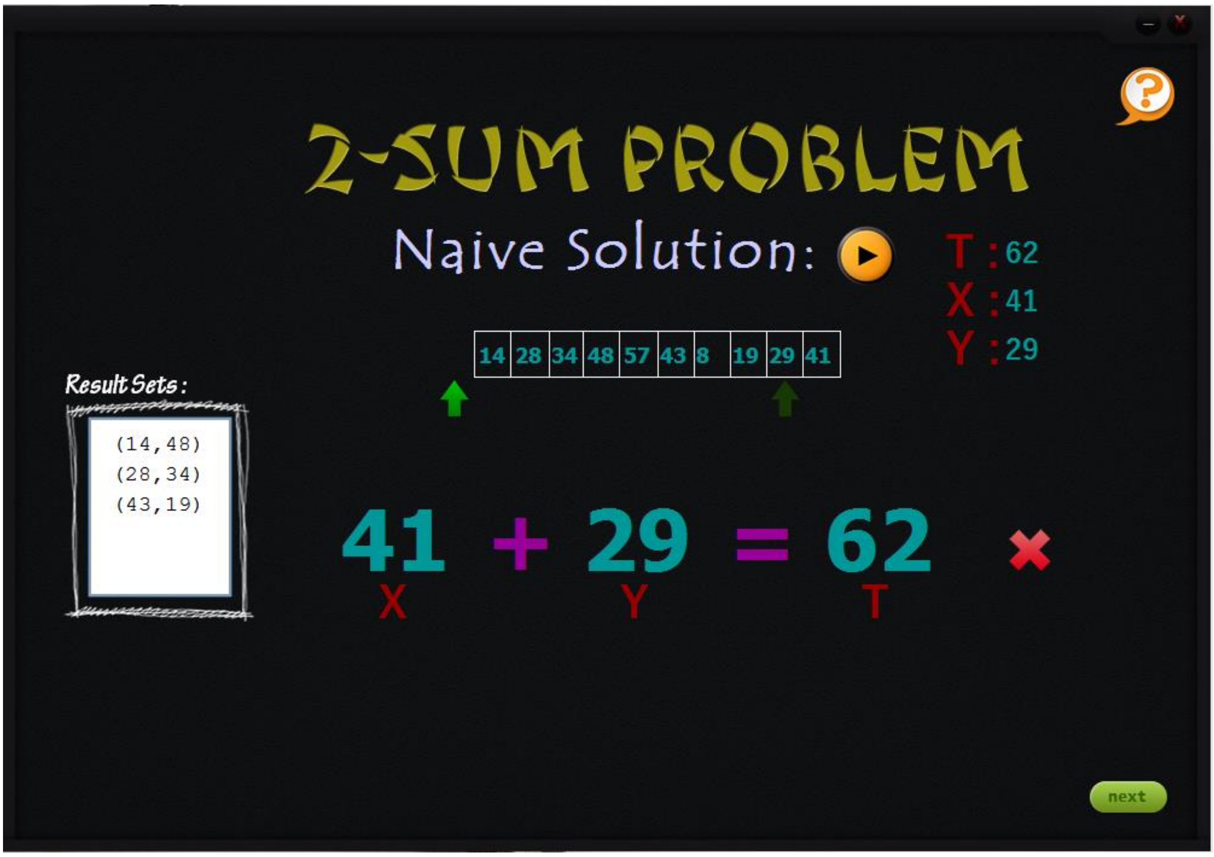
2-SUM PROBLEM

How many numbers: 10

What are they ? 14,28,34,48,57,43,8,19,29,41

Give the target sum: 62

**Figure 5.2** User Input

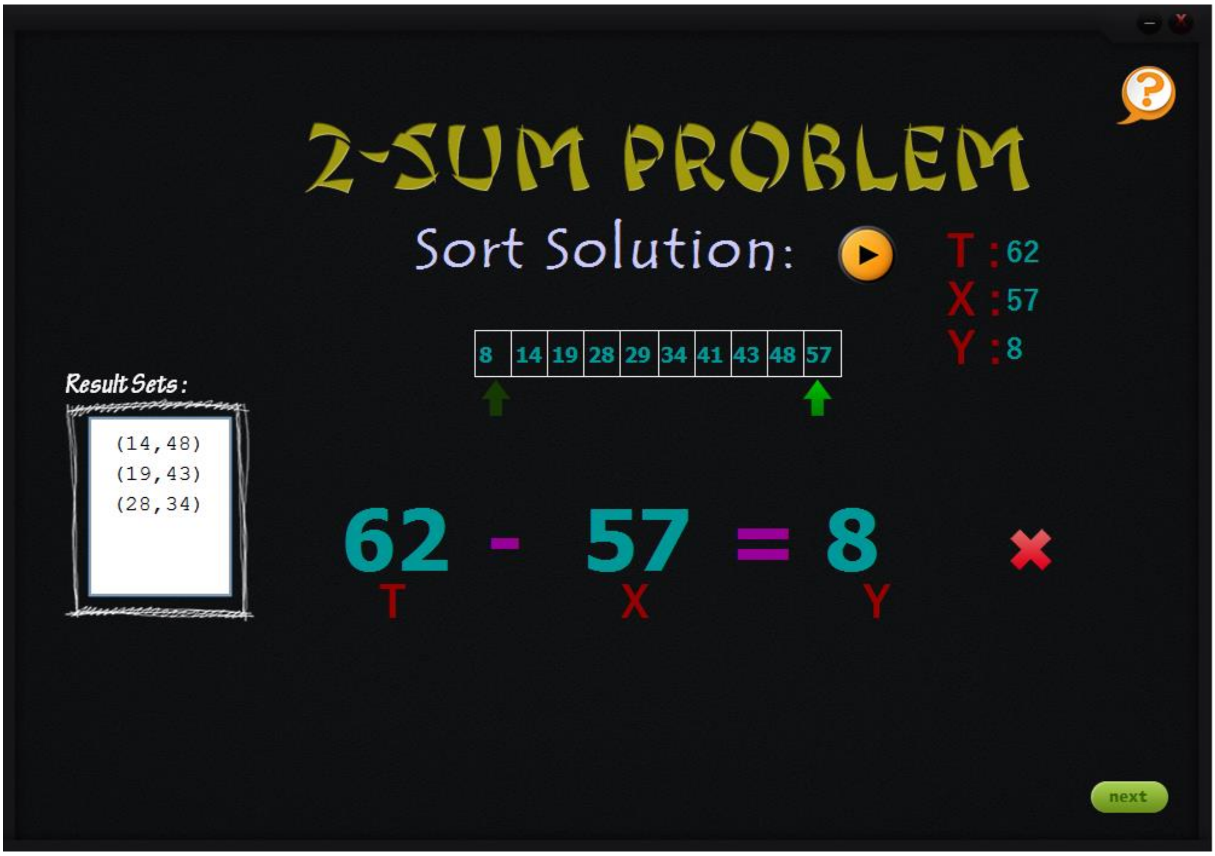


T : 62
X : 41
Y : 29

Result Sets :

(14,48)
(28,34)
(43,19)

**Figure 5.3** Naïve Solution

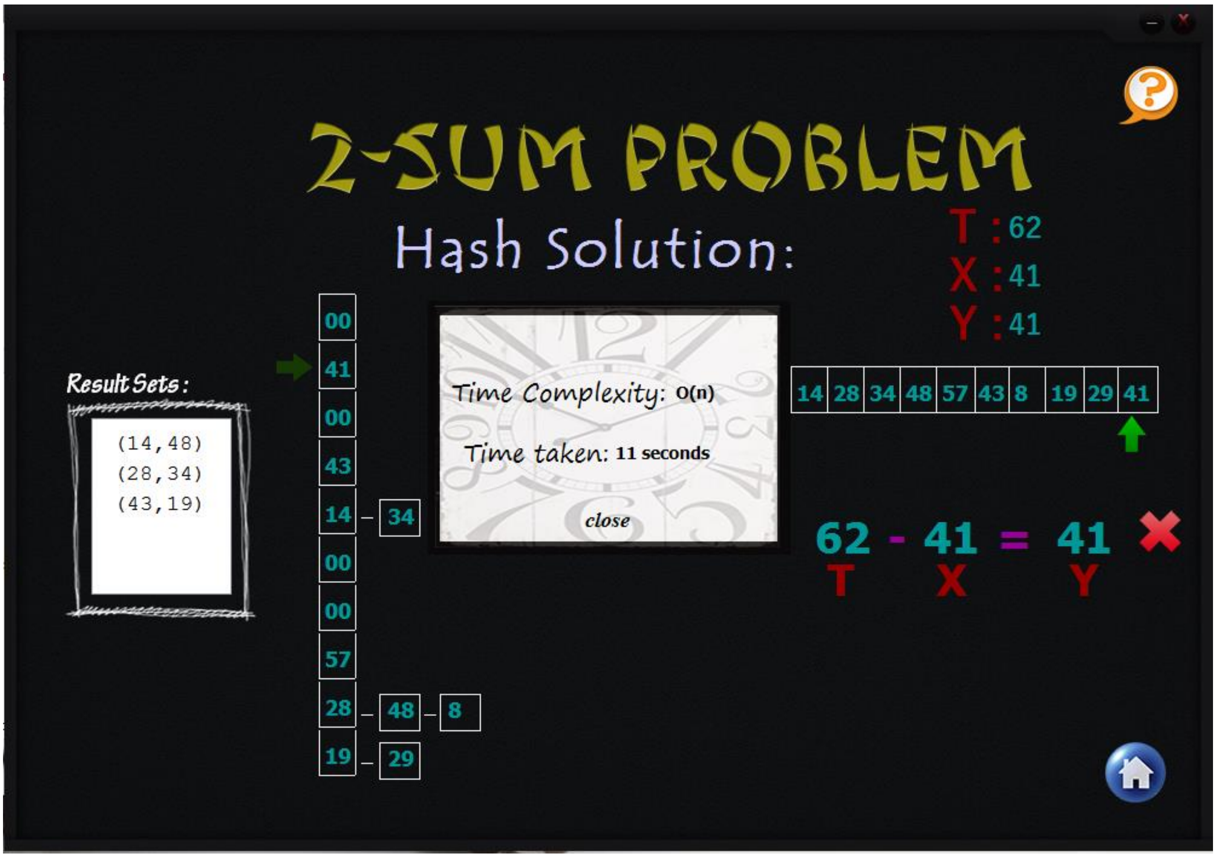


| 8 | 14 | 19 | 28 | 29 | 34 | 41 | 43 | 48 | 57 |
|---|---|---|---|---|---|---|---|---|---|

```
(14,48)
(19,43)
(28,34)
```

$$\underset{T}{62} - \underset{X}{57} = \underset{Y}{8}$$ ✖

**Figure 5.4** Sort Solution



Result Sets :

(14,48)
(28,34)
(43,19)

Time Complexity: O(n)

Time taken: 11 seconds

**Figure 5.5** Hash Solution

## 6. CONCLUSION

Hashing provides a more reliable and flexible method of data retrieval than any other data structure. It is faster than searching arrays and lists.

Unlike any other data structure hashing does not determine what speed you will get; with hashing one can choose the time-space trade off to make. You control either the speed by picking the amount of space for the hash table; or you control the space by picking a speed of retrieval.

However hashing does not do a good job of sorting data, since it work by randomizing not ordering data. This is a disadvantage if you want to present an ordered list of the data, not just retrieve it.

# 7. BIBILIOGRAPHY/REFERENCE

[1] http://www.wikipedia.com/

[2] http://www.google.com/

[3] http://stackoverflow.com/

[4] https://class.coursera.org/algo-004/lecture /64

[5] https://www.udacity.com/