Element Hunt (Educational Game)

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Abstract: This paper is based on an in-depth analysis of a gaming system and how it is beneficial to the young generation for solving different problems and uplifting Indian ethos. The system is a game application that utilizes the concept of the periodic table of chemistry. Keeping the interests of children in mind, we have designed this system that is based on the concept of the periodic table of chemistry. Each level represents an element of the periodic table and the properties of the elements are utilized to generate a solution for a given problem. The game has four steps: (i) Storytelling that emphasizes Indian ethos, (ii) Play and complete a specific level, (iii) Attempt and pass the MCQ. Thus, the objective of our research work is to enable the youth to gain knowledge in the specific field by playing this educational game.

Keywords: Game, Knowledge, Storytelling, MCQ, Ethos, Chemistry Periodic table.

1. INTRODUCTION

The advancement of technology has created a significant impact on people's lives around the world. The impact of emerging technology can be seen in a variety of fields like health-care, education, game, scientific research, etc.

In the present generation, digital games have gained significance and are the most widely performed activities by the young generation. This has created a major impact on the education system.For a few decades, there is an increase in the demand for digital games. There is a variety of games that enriches the knowledge of people by causing them to utilize their analytical thoughts and ideas to complete the requisite tasks. Games like Smarty Pants, Jumpstart Escape, and Adventure Island - Nintendo Wii are considered to be popular educational games. These games act as tools to improve a student's learning ability and enhance their skills in different fields like mathematics, history, general knowledge, etc. The education which is provided through these games creates a positive impact in the minds of the people and thereby enables them to improve their performance skills.

Digital game is a large domain which consists of different types of games, and each genre has its own importance and interest. These games are described below.
1. Adventure Games- Adventure games feature minimal combat, focusing mainly on narrative and puzzle-solving to progress in the game. Text-based games and interactive novels are also considered adventure games.
2. Action Games – In these games, a player is in control of and at the center of the action, which mainly comprises of physical challenges which a player must overcome. Most early video games like Donkey Kong and Galaga fall into the action category.
3. Simulation Video Games - Games in the simulation genre have one thing in common- they are all designed to emulate real or fictional reality, to simulate a real situationorevent like SimCity, Nintendogs, etc.
4. Fighting Games - Fighting games are also known as "Versus Fighting Game" is a video game genre that involves combat between two (or more) players. Fighting game combat features mechanics such as blocking, grappling, counterattacking, and chaining attacks together into "combos".
5. Adventure Games - Adventure games feature minimal combat, focusing mainly on narrative and puzzle-solving to progress in the game. Text-based games and interactive novels are also considered adventure games.
6. Strategy Games - Strategy games give players godlike access to the world and its resources. These games require players to use carefully developed strategies and tactics to overcome challenges.
7. Casual Games - Casual games exhibit basic game mechanics and are perfect for short, casual sessions. Developers often use rewards and carefully designed levels to keep players striving to get further because gameplay in this game is usually quite repetitive.
8. Tower Defense Games - These games have a very simple layout. Usually, computer-controlled monsters move along a set path, and the players must place, or "build" towers along this path to kill the enemies. In some games,

towers are placed along a set path for the enemies, while in others' towers can interrupt enemy movement and change their path.

9. Multiplayer Online Battle Arena (MOBA) Games - MOBA games involve two teams competing against each other in a predefined environment.

10. Interactive Fiction Games -Interactive fiction can also occur in the context of a game world such as an adventure game with a player-influenced narrative.

11. Educational Games - Games like Quiz can be said to come under educational game as it mainly focuses on providing some knowledge to the player playing this game.

Each genre of games mentioned above have their specific purpose and can be researched as a whole new topic.Also, when we investigate all of these different gaming genres, we will see that people of various ages from all over the world may be classified into each of these categories.

As previously said, the effect of technology has demonstrated that today's youth spends a significant amount of time playing games, which does not assist them to educate themselves. That's why we thought to research in the gaming domain so that a solution can be found to this very problem. During our research and study, we observed that the children (that is anyone in their adolescence)have the capability to learn things in a much quicker way but they are not able to learn in that way. So, we thought to find a solution, which we will explore in detail in the coming portion of this research, keeping children in mind.

As a result, we are interested in the gaming industry since about 3.07 billion individuals worldwide play desktop or mobile games. Each person spends over 9 hours a day playing these games, which adds no value to the individual.

Up till now, we got the idea of advantages and disadvantages of technology, and different genres of games, and why we choose "Educational Game" as our topic for research which led us to develop an educational game named "Elements Hunt". Actually "Elements Hunt" is a blend of both "Adventure Game" as well as "Educational Game". Now, in the next section, we will go through the different aspects of this game, how to use it, and the benefit of playing this game.

1.1 LITERATURE REVIEW

1) In [1], the authors have attempted to offer specific details on how gaming in education might benefit pupils. It is also examined how existing technology and improvements may be used to create a more advanced gaming system. The major goal of this research is to disprove the myth that using video games for educational purposes would simply cause students to be distracted from their studies. Also, after reading this paper, we will be able to understand the various ways in which the use of games in education can benefit students, such as assisting in critical thinking development, developing an enthusiastic learner, motivating and engaging students, reducing monotonous learning methods, and assisting students with focus, self-esteem, and memory.

2) In [2], is based on Uncommon Scents, an award-winning science-based game. Uncommon Scents is one of a series of scientific teaching games on drugs and alcohol. The game was created specifically for middle school children to teach them about the biological repercussions of harmful chemical exposure in an environmental science setting, as well as the dangers of misusing these compounds as inhalants, according to this research. The major purpose of the game presented in this research was to give interactive science-based drug education as well as factual information on the hazards of breathing harmful substances, which would lead to more unfavourable attitudes about inhalants. The game's avoidance of direct and fear-based anti-inhalant messaging, which have been shown to be less convincing than non-threatening, indirect signals, is a key tactic for attaining an attitude adjustment. Uncommon Scents was created to educate middle school pupils about the biological effects of harmful chemical exposure and the dangers of employing these compounds as inhalants. The research presented in this paper suggests that mixing games and teaching can aid in young participation in research.

3) In [3] , with the use of contemporary mobile technologies, the authors have expressed their goal for creating a system that would motivate students to stabilize and extend their knowledge in a sustainable and engaging manner. The use of Extended Mobile Gaming Education (eMgage) is also provided in detail in this research. The paper's work centers around a quiz-based mobile learning application that are added with gaming elements features in order to upraise students' motivation and engagement, two of the most crucial learning requirements. The goal of this research paper is to create an environment where different game methods and their dynamics can be utilized to create happy stability of knowledge and student engagement.

4) In [4], the authors looked at the topic of e-learning platforms, such as e-learning environments, which provide passive educational models focused on storing knowledge that is delivered or consumed rather than learned, and where contemporary educational lore receives little attention. And how educational games may be combined with e-learning

platforms to boost motivation and improve the quality of the learning experience. The authors' key argument in this study article is that there is a lack of systematic design and execution of educational games, which, if adopted, offer a tremendous potential to make learning more interesting and engaging. After a thorough examination of several methods to the creation of educational digital games, the authors have attempted to present a solution as a universal game design process that incorporates adaptability and assessment characteristics in this work. Finally, in light of its relevance to various implementations and situations, the authors have supplied a specific implementation of that concept.

5)   In [5], it examines one of this generation's most pressing issues: the spread of fraudulent material and disinformation. Many analysts believe that in today's environment, a country's power comes from its ability to handle information warfare. As a result, it's critical to develop a mechanism to deal with the dissemination of false information, which this article attempts to do by proposing a solution in the shape of a game called MAthE the Game. The authors of this work provide a full description, as well as the creation and interface design of a web-based gaming application in which a player must determine whether an article displayed is genuine or not. The participants can employ tools and techniques for detecting important information about the cues that frame a news item in order to arrive at the proper conclusion (title, date, creator, source, containing images). The methodological and technological framework of a serious game design is the subject of this paper's research, which aims to provide instruction and training in media authentication. With the use of an interactive and entertaining game, the major goal of this research project is to teach individuals about different tools, methods, and strategies so that they can decide if the supplied news or information is authentic or fake. This also demonstrates how essential a game can be in the sphere of education by presenting valuable knowledge in a creative manner.

1.2 DESCRIPTION OF THE SYSTEM: ELEMENTS HUNT - THE EDUCATIONAL GAME

"Elements Hunt" is an educational game that is based on the concept of the periodic table of chemistry, where the player will be able to learn different elements of the periodic table and their properties subconsciously.

1.2.1 About Elements Hunt
Elements Hunt is a game console system which is mainly an education-based game, and it provides excitement of "Adventure Game". In our childhood we used to listen to stories from different sources and are able to effortlessly grasp and memorize them and also remember them for a long time. Keeping this in mind, we have tried to put the storytelling part in the game which will help in creating interest among the students to play the game, and eventually enhance knowledge from this game. Storytelling is an important part of the Elements Hunt game After all our research and its implementation (i.e., development of Elements Hunt game) is based on the idea that there should be a proper gaming application where the player can increase their productivity (i.e., they can learn something with respect to time). The success of this research depends on the number of players playing the game. Therefore, we found that if we include this storytelling part in our game, then it will make the game more interesting and will increase the number of players.
The Elements Hunt game mainly consists of three components Storytelling, Console playing, and Quiz.

1.2.2 Steps of Elements Hunt
The Elements Hunt is a system that consists of three parts which are discussed below: -

I.   Storytelling

Each level in the game, which basically represents each element of the periodic table, starts with a story related to the respective level. Here all the stories of each level are related to each other. In the story there is a main character who is a moderate student. One day he reached to school late. As a result he was given punishment that the next day he should come after remembering all the elements of the periodic table and their properties. He returned home and began to study with a stronger level of determination than before, but after some time he got lost in his dream in which he began his voyage of discovering elements and their qualities. In his dream, he was wandering around and then suddenly met with a sorcerer. He asked the sorcerer if he could help him learn elements of the periodic table and their properties. The sorcerer told him that he can help the boy in learning only if he (the main character) will help him (the sorcerer) in return. Then both agreed to help each other, and the sorcerer took the boy to a place where he showed him a helpless woman who was very sick. And the sorcerer told him that the medicine (medicine where nothing other than the elements of the periodic table) needed to cure this woman is very rare and the place where it is found was too dangerous and the sorcerer asked the boy if he can do this task. The boy agreed to do the task and he started to find the medicine (basic elements of the periodic table). After this the next step of the Elements Hunt game that is the interactive console playing part starts.

II.   Interactive Game Play

In this step there are different elements and these elements are described below.

1.   A character- This is the main character of the game that is the boy who is looking for medicine to cure the ailing woman.

2.   Collectible - There are different objects present in the gameplay which the player needs to collect because this will help in increasing the score of the player and help in climbing them to the top of the leader board. The score will increase with the number of objects collected by the player.

3.   Clock- As the gameplay starts, the player gets a fixed amount of life, and this life keeps decreasing as time passes. To regain life the player needs to collect an object displayed as a "clock".

4.   Enemies- To make the game competitive and interesting this game also includes different enemies from whom the player needs to save himself.

5.   Interactive Board- In the gameplay, the player will also encounter a board that will show some important facts related to the respective elements of that level, which will help the player to answer questions in the quiz section. When the user sees this board, he or she needs to press the key "E" in order to see the facts that are displayed on the board.

Figure 1-Interactive Board appears during game play

6.   Exit Gate- The "Exit Gate" is a gate to reach to the next section.
As soon as the user reaches the Exit Gate, he orshe is prompted to the next section which is the "Quiz".

III.   The Quiz

This is the final step of the game. Upon successfully completing this step, the user will be allowed to play the next level. In this step, there are five questions that are asked which are related to the element of the respective level, and the player needs to answer to all the questions accurately.

On getting all correct answers they will be allowed to proceed to the next level. If the user is not able to answer all the questions correctly then he or she will be asked to play the quiz again until all the questions are answered correctly.

Figure 2- Questions shown during mcq solving

After successful completion of the quiz, a board will be displayed where the user will be able to seethe top scorers of the game.

The above description about the game depicts that this game is a combination of education and adventure that grabs the attention of the users and inspires them to play the game. Furthermore, this game symbolizes Indian ethos and culture.

1.2.3 Interface of Elements Hunt

This section describes the interface of the game –Element Hunt. A detailed description of different components of this game is illustrated below.

1. User Details - After starting the game, the first page is shown that asks the user about his or her details like name and email id. These data are used to refer to the respective score of the player upon successful completion of a level.

2. All Control - We named this part as "All Control" because all controls related to the game and the information about the game is present in this segment. This control information is described below.

Figure 3-All the details regarding game is present here

2.1 Rules - On the top-right corner of the "All Control" section, an icon is present clicking on which, all rules related to game is shown. In addition, description of different objects encountered by the player during the "Interactive Game Play" is provided there.
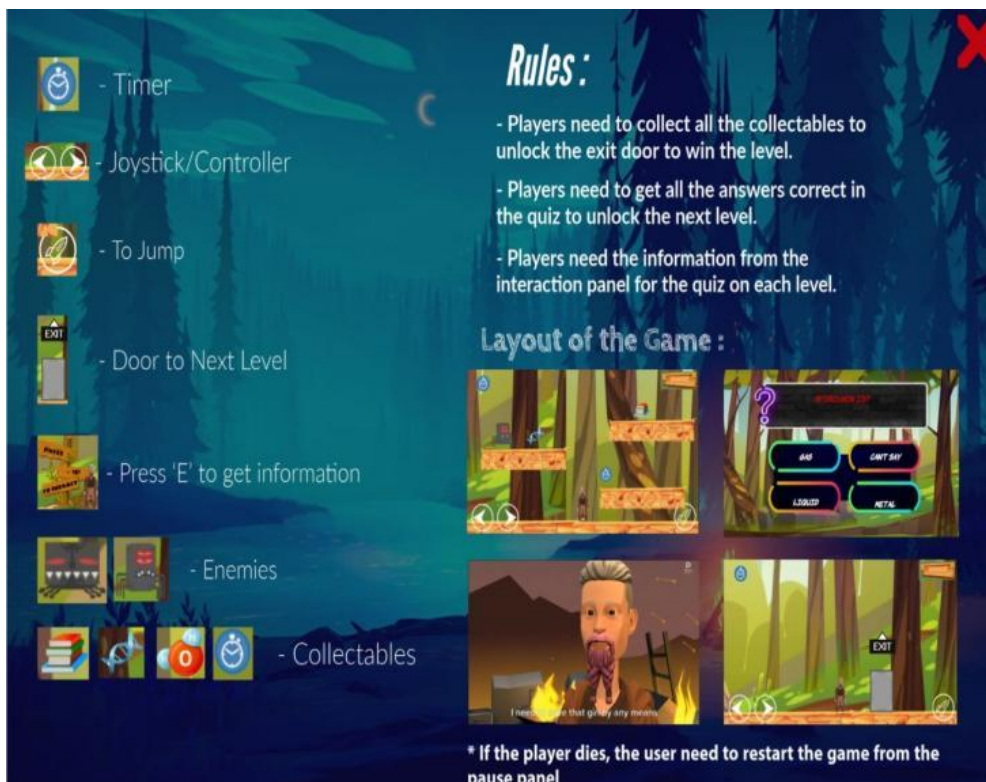

Figure 4-Rules regarding game play is shown above

2.2 Story mode - Clicking on this icon, the user will be prompted to the next section where the different levels of the game will be shown. This icon is present in the middle part of the "All Control" section.

2.2.1 Game Levels - After the "All Control" section, the next section which shows is the "Game Level" section, where different levels of the game will be shown. The user will be able to play any level after clicking on the specific level. provided that the player has successfully completed previous levels.

Figure 5-Levels of game are displayed

2.2.1.1 Game Play - This is the most important segment of the game. This part consists of three steps and they are Storytelling, Interactive Game Play and The Quiz.

2.3 Inventory - On the top left corner of the "All Control" section, an icon is present which is like an inventory. Clicking on this icon will show us different elements of the periodic table in the card form and after clicking on any of these cards (represents elements of the periodic table), the player is directed to a new segment that contains the following information.

Figure 6- Cards representing each elements of periodic table

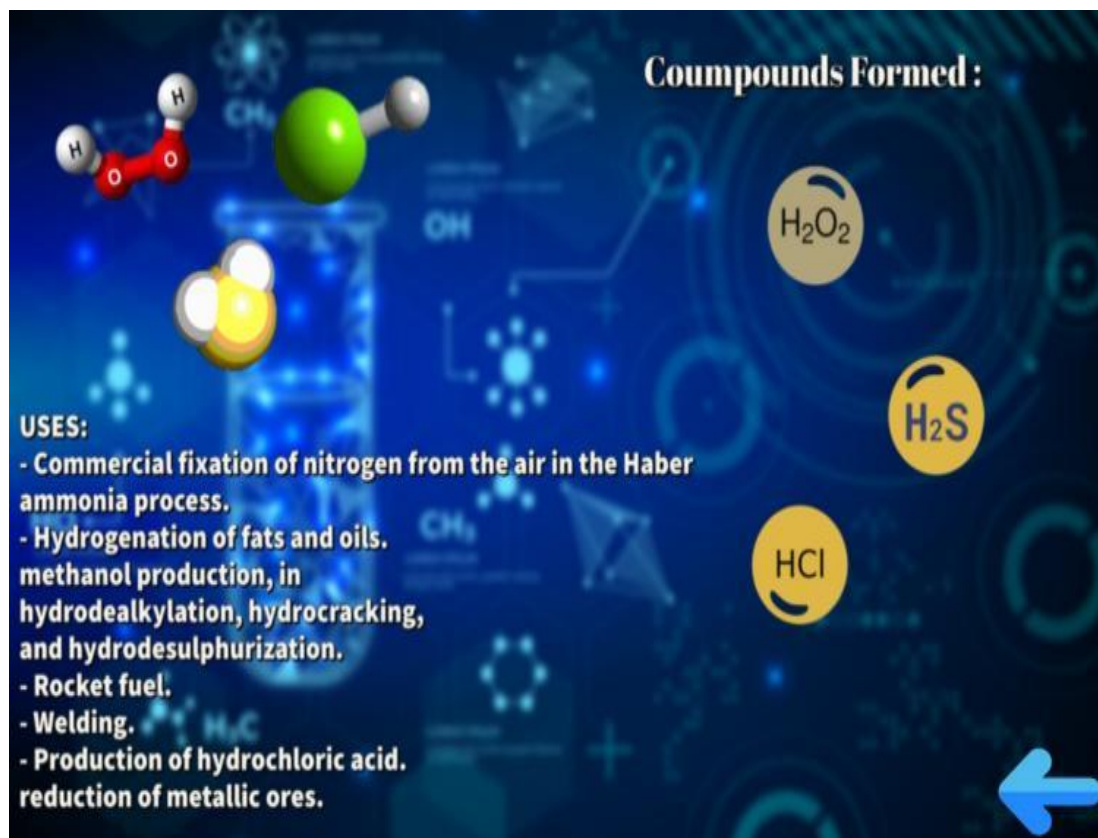2.3.1 3D model of the atomic orbitals of the respective element.

Figure 7-Properties of the respective element is shown here

2.3.2 In this section, different properties of the elements are shown, and the product of their reaction is also shown here.

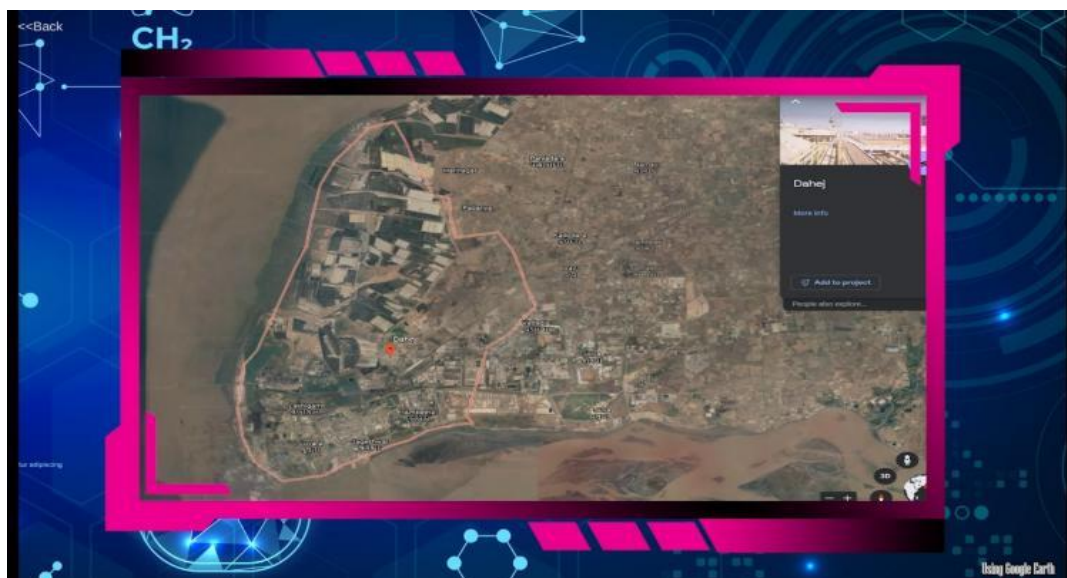**Figure 8-Properties of elements**

2.3.3 A map showing the location of places where the elements are found in abundanceor manufactured.

Figure 9- Locating the place where specific element is found in abundance

The primary objective is to provide all related information about the elements in one place. This will help the player to learn easily and also with the information provided here they will be easily able to answer all the questions in the Quiz section.

2.4 Leaderboard - Just below the "Inventory", an icon as a trophy is present, which is for viewing the leaderboard. Clicking on this icon will cause proceed to the leaderboard where the top scorers of the game will be shown in descending order.
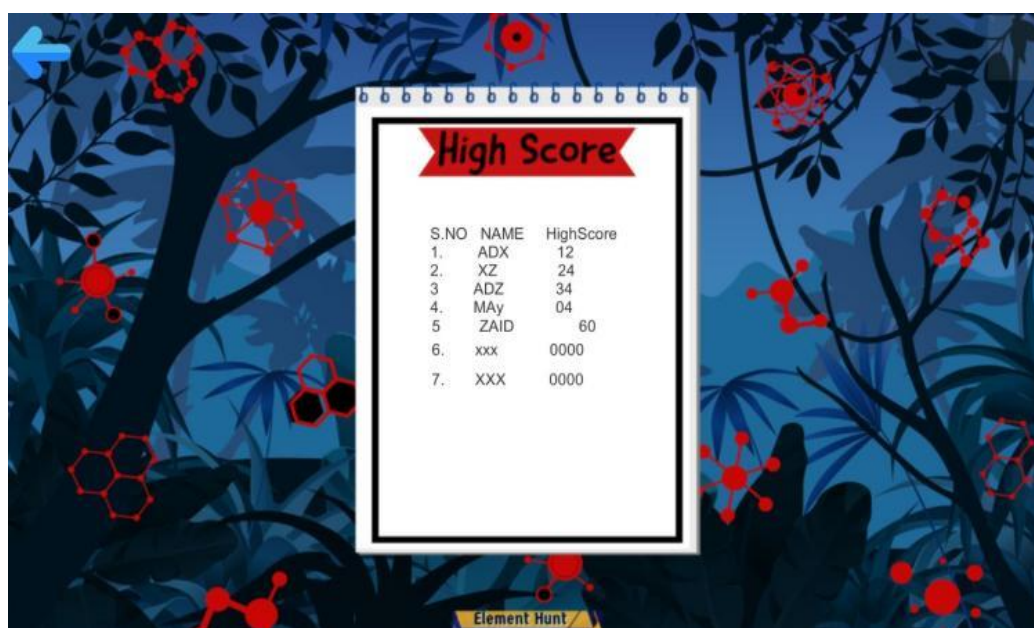
Figure 10-Box displaying scores & position of the player

2.5 Sound Control - The user can play and pause the sound system of the game by clicking on the sound icon present at the bottom-right corner.

2.6 Contact & Support - During the game play, if the user faces any kind of issue then they can contact the Help and Support team by clicking on the icon present at the bottom-left corner of the "All Control" section.

2.7 Exit Button - This button is present in the middle part, and this button is used to exit from the game application. All of the parts mentioned above are combined to form the Element Hunt- a single system gaming application which is an education based gaming application.

1.3 TECH STACK

A tech stack is the combination of technologies that a company uses to build and run an application or project. Sometimes it is called a "solutions stack". A tech stack typically consists of programming languages, frameworks, database, front-end tools, back-end tools, and applications connected via APIs (Application Programming Interfaces).

To build the Elements Hunt game the following tech stack is used (or some other might be used as per requirement in the future): -

1. C# - C# (pronounced "See Sharp") is a modern, object-oriented, and type-safe programming language. C# enables developers to build many types of secure and robust applications that run in .NET. C# has its roots in the C family of languages and will be immediately familiar to C, C++, Java, and JavaScript programmers.
C# emphasizes versioning to ensure programs and libraries can evolve over time in a compatible manner. Aspects of C#'s design that were directly influenced by versioning considerations include the separate virtual and override modifiers, the rules for method overload resolution, and support for explicit interface member declarations.

2. Unity-3D Engine - Unity3D is a powerful cross-platform 3D engine and a user-friendly development environment. Easy enough for the beginner and powerful enough for the expert; Unity should interest anybody who wants to easily create 3D games and applications for mobile, desktop, web and consoles.

3. Firebase Realtime Database - The Firebase Realtime Database is a cloud-hosted database in which data is stored as JSON. The data is synchronized in real-time to every connected client. All of our clients share one Realtime Database instance and automatically receive updates with the newest data, when we build cross-platform applications with our iOS, and JavaScript SDKs. The Firebase Realtime Database is a NoSQL database from which we can store and sync the data between our users in real-time. It is a big JSON object which the developers can manage in real-time. By using a single API, the Firebase database provides the application with the current value of the data and updates to that data. Real-time syncing makes it easy for our users to access their data from any device, be it web or mobile. The Realtime database helps our users collaborate with one another. It ships with mobile and web SDKs, which allow us to build our app without the need for servers. When our users go offline, the Real-time Database SDKs use local cache on the device for serving and storing changes. The local data is automatically synchronized when the device comes online.

Different technological tools that are used during the development of the Elements Hunt game are: -

1.   VS Code - Visual Studio Code is a source-code editor made by Microsoft for Windows, Linux, and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git.

2.   Blender - Blender is a free and open-source3D computer graphics software tool set used for creating animated films, visual effects, art, 3D printed models, motion graphics, interactive 3D applications, virtual reality, and computer games. Blender's features include 3D modeling, UV unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculpting, animating, match moving, rendering, motion graphics, video editing, and compositing.

1.4 DESIGN OF THE SYSTEM

The working of Element Hunt game system is depicted in the data flow diagram as follows, where we have tried to explain all the minute details of this game console system using three level of data flow diagrams (DFDs).
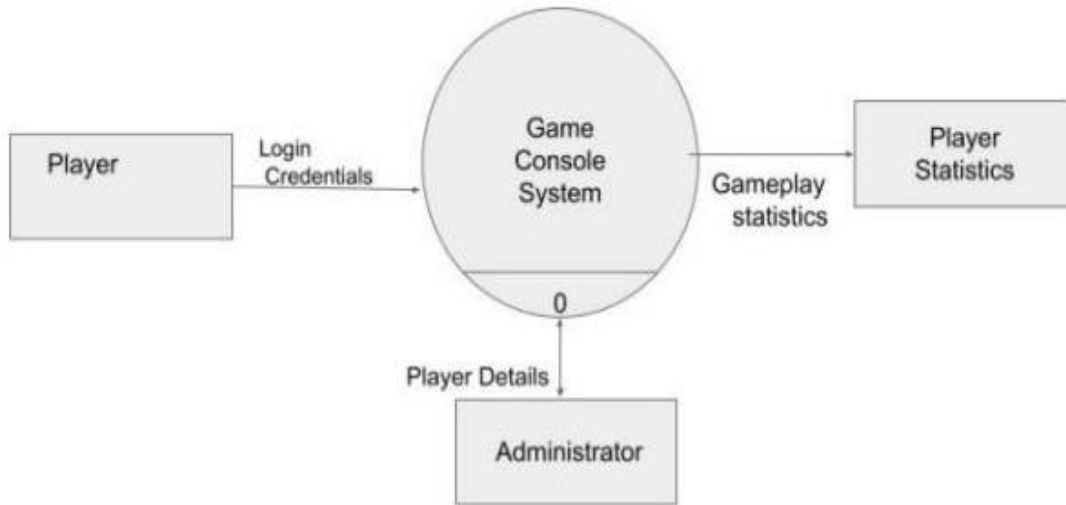
Level -0 DFD:
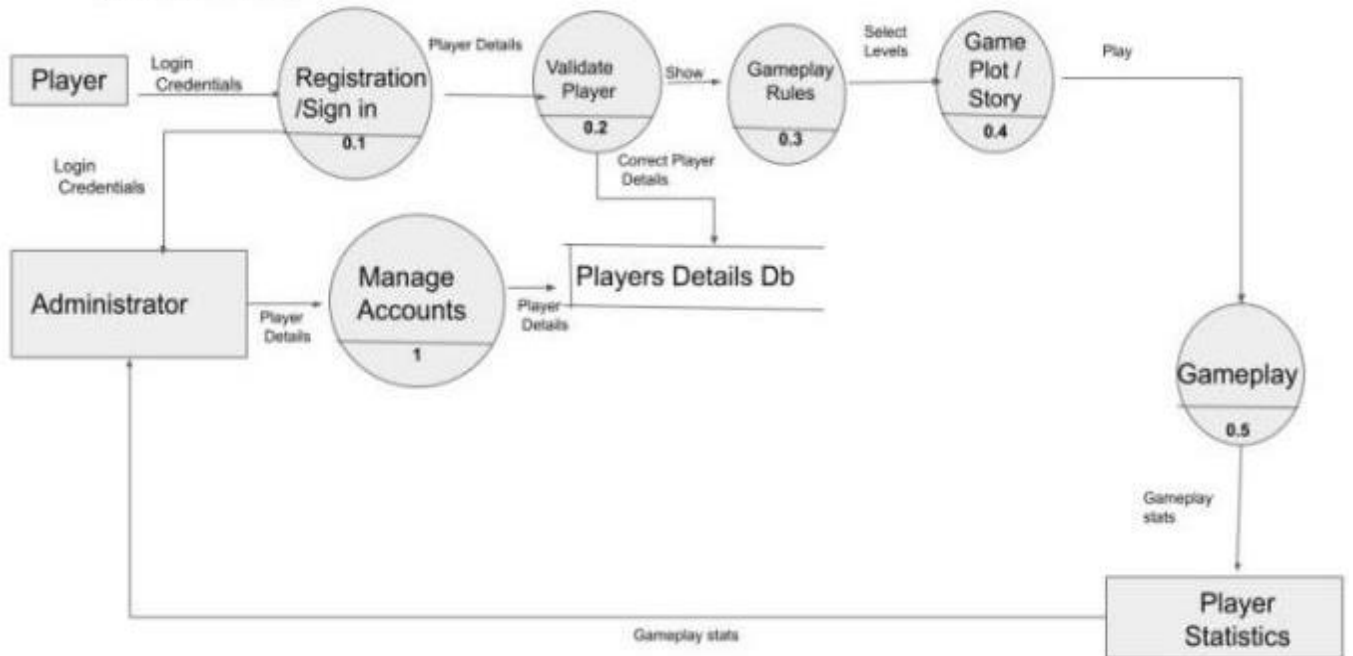

Figure 11-DFD of level-0
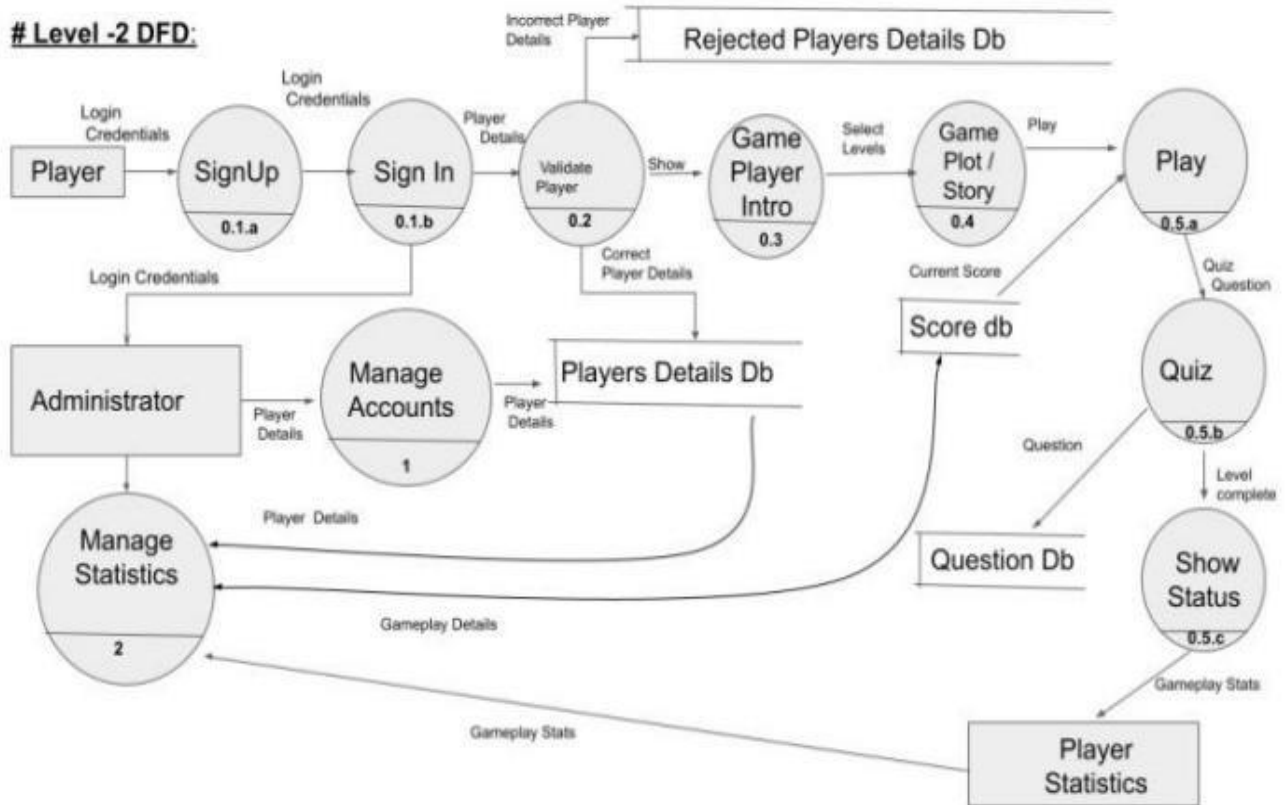

Figure 12-DFD of level-1

Figure 13- DFD of level-2

The data flow diagram shown above describes the different parts (or components) of the system and interaction between each of the processes (components) through the flow of data among them.

Level-0 DFD depicts that there is a single entity called Game Console System. In this system, a user can register and play the game. User will also be prompted a statistics screen after successfully completing the specific level.
Level-1 and Level-2 DFDs depicts a detailed analysis of the system like Manage Account entity, Sign-up and Sign-in section, and Databases used in this system.

Detailed overview of different databases that are used to maintain information generated in this system is shown below.

DATA DICTIONARY FOR GAME CONSOLE SYSTEM

❖ **Player Details Table**: - This table contains the details about the successfully registered player.

ATTRIBUTE	DATA TYPE	UNIQUE	DESCRIPTION
P_Id	INTEGER	Yes	Unique id for registered players (Primary key)
Name	VARCHAR	No	Name of the registered player
Email_Id	VARCHAR	Yes	Email of the registered player
Mobile	VARCHAR	No	Mobile number with which player registered
Password	VARCHAR	No	Password for the sign in
R_Date	DATE	No	Date on which player registered

Figure 14-Data dictionary of Player Details table

❖ **Rejected Player Details Table**: - This table contains the details about the player who were unable to register successfully.

ATTRIBUTE	DATA TYPE	UNIQUE	DESCRIPTION
P_Id	INTEGER	Yes	Unique id for players who tried to register (Primary Key)
Name	VARCHAR	No	Name with which player tried to registered
Email_Id	VARCHAR	Yes	Email with which player tried to registered
Mobile	VARCHAR	No	Mobile number with which player tried to registered
UR_Date	DATE	No	Date on which player tried to register

Figure 15-Data dictionary of Rejected Player Details table

❖ **Score Table**: - This table contains the details about the score of each player.

ATTRIBUTE	DATA TYPE	UNIQUE	DESCRIPTION
P_Id	INTEGER	Yes	Unique id for registered players (Primary Key)
Score	INTEGER	No	Best score of the player till recent
Last_Updated_Date	DATE	No	Last date on which score was modified

❖ **Questions Table**: - This table contains the information about the question associated with each level together with the possible options and correct answer.

Figure 16-Data dictionary of Score table

ATTRIBUTE	DATA TYPE	UNIQUE	DESCRIPTION
Q_Id	INTEGER	Yes	Unique id for each question (Primary Key)
Level	VARCHAR	No	Level with which the question is associated
Question	VARCHAR	Yes	Details about the question
Option_1	VARCHAR	No	First possible correct option for the corresponding question
Option_2	VARCHAR	No	Second possible correct option for the corresponding question
Option_3	VARCHAR	No	Third possible correct option for the corresponding question
Option_4	VARCHAR	No	Fourth possible correct option for the corresponding question
Correct_ans	VARCHAR	No	Correct answer for the corresponding question

Figure 17-Data dictionary of Questions table

1.5 Algorithms

1.5.1 Basic structure of the Game

Step-1: Start.
Step 2: Enter credentials.

Figure 18-Asking for user details as the application opens

Step 2.1: Welcome Screen Appears.
Step 3: Storytelling
Step 4: Interactive game play starts.
Step 4.1: Resist enemies and collect items.
Step 4.2:. Press 'E' to start interaction.
Step 4.3: Unlock doors after collecting all elements.
Step 5: Begin Quiz
Step 5.1: Attempt questions.
Step 5.2: Display score board.
Step 5.3: If pass repeat Step-3 to Step-5 till the end of periodic table.
Step 5.4: If pass and end of the game, play Bonus Round
Step 5.4.1: Tap on Bonus level.
Step 5.4.2: Attempt quiz.
Step 5.4.3: If all answers correct then get a reward and exit.
Step 5.4.4: If fail, exit.
Step 5.5: If fail exit.

1.6 CONCLUSION

Game-based education enables users to learn and transform the education system to a more exciting approach that enable them to enhance their knowledge and skills in different fields. We know that a sophisticated gaming system helps to improve a user's performance and understanding of the learning process, and allow them to gather knowledge from education based gaming application.

Our game "Elements Hunt" enlightens the user with comprehensive knowledge about periodic table that is used in chemistry.
This game can be used by different educational organization to teach them the concept of periodic table in a simple and interactive way, which can help in increasing the number of students involvement in learning process.

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