

TechGame – Learn with Games – An AR Experience

Dr. Ekta Upadhyay¹, Khushal Hurbada², Kannan Maharajan³, Jignesh Vaidya⁴

¹Associate Professor, Dept. Of Computer Engineering, Universal College of Engineering, Mumbai, India

^{2,3,4}UG Student, Dept. of Computer Engineering, Universal College of Engineering, Mumbai, India

Abstract – This paper explores and provides a vision to an idea of using Game-based Augmented Reality approach to make easy-to-use and interactive User Interface & to simplify the learning process in the field of Education. It explains how Unity 3D can be used to build AR applications that can enable learning of various subjects and skill the proficiency by playing an AR game in a Test manner. The user can experience variety of levels w.r.t. Time Complexity & difficulty of questions from various Subjects. Detailed information on the Structure, Proposed System, Methodology & Implementations, along with some executed results is given in this paper. We've tried to uncover some possible research opportunities for game-based approach in Education. It concludes with encouraging fellow researchers to look deeper into this topic by enlisting the points for Future Scope of this application.

Key Words: Game, Augmented Reality, Education, Unity 3D, e-learning.

1. INTRODUCTION

The educational system has always taken long time to change & accept new ways of innovation and evolution. In most of the educational institutions, basic concepts are either explained in terms of diagrams or animated videos where the user has no control over it leading them to lose interest. But with this Pandemic bringing us all to halt, Work-from-home and e-learning have being practiced widely now. With these tough times allowing us to sit at home and experiment and innovate new and optimal ways to get things done, Education has suffered for its own, with students and teachers finding it hard to adapt e-learning. Now is the need to get their focus & concentration back into studying.

For learning, various e-learning software like BYJU'S^[7], WhiteHat Jr^[8], UpGrad^[9], etc. are available to teach with Video lectures (Live + Recorded), but for self-analysis and a proper game-based approach, applications like Kahoot^[10] & Mentimeter^[11] are the best examples. With changes to UI and a theme-based gameplay, we have tried to make learning more interesting and interactive with an Augmented Reality gameplay application "TechGame" for Android.

For centuries, games are considered to be a great learning tool. For Example. Chess was used to increase strategic thinking. The core concept of game-based learning is teaching through failure, repetition and the accomplishment of goals. Games that are planned and designed well will offer enough difficulty to keep it challenging and fun while still

being easy enough for the player to win. Game-based learning takes this same concept and applies it to teaching a curriculum. The result is active learning instead of passive learning.

[1] Unity is a game engine which is used for making games, artwork and motion pictures. It can be extended to make applications for serious purposes like simulators and algorithm testing. Unity applications are made using Unity Editor. Applications can be deployed on various platforms like web, mobile, desktop, gaming console.[1]

"TechGame" is an Android AR gameplay with defined Learning Outcomes. It is designed to balance syllabus learning with gameplay and the ability of the player to retain and apply said subject matter. Its design describes an approach to teaching and testing the proficiency, where students explore relevant aspects of games in a learning context within an effective game-based learning environment.

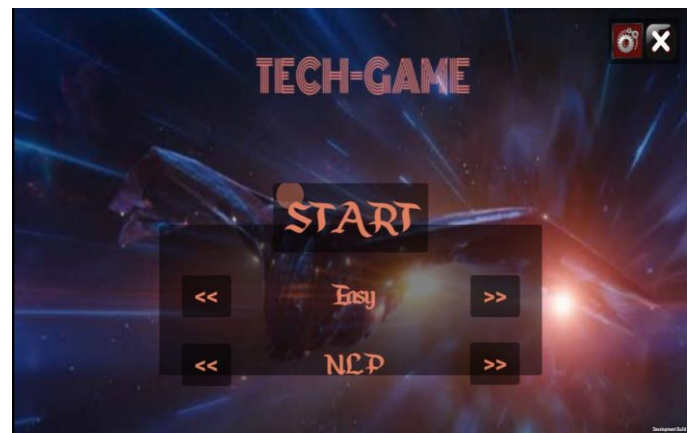


Figure 1: TechGame UI

2. Literature Survey

The following research paper were reviewed considering same topic of interest or relevant to that of ours to get deeper in our research work.

Lavina Nagpal, Meghna Jaglan, Anuraj Kathait, Aakil Mathur, and Abhishek Vichare from Manipal University are the authors of the paper "SOUL: Simulation of Objects in Unity for Learning", which was published in 2019 at 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT) which is referred for the core of our project, Unity, on which our application is built. They proposed a Multi-purpose Web-App to simulate objects

in UNITY for Learning. But as we know, “Multiple Objectives diversifies the goal” is exactly why their aim was never brought to execution. Knowing more of Unity, and that being their main aim, they actually made limited use of Unity. The essence in their vision was true, which gave us a clarity on the Research gap and made us focus on the goal to use Unity for an AR game to simplify learning. Their research helped us to gain more knowledge on the implementation of the project, use of Unity, the available resources and the need of TechGame.[1]

Mauricio R A Souza, Lucas Veado, Renata Teles Moreira, Eduardo Figueiredo, and Heitor Costa are the authors of the paper “Games for Learning” published in 2017 at IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track. It focuses mainly on the research part of how game-related methods support and are used for specific knowledge areas like Software Process, Software Design & Profession Practice from Software Engineering point of view. The research structure revolves around the Statistic & Research-purpose numbers based on Gamification, Game Based Learning (GBL), Game Development Based Learning (GDBL) & Hybrid learning patterns acknowledged and accepted for Education. Mainly, information from sources like research papers & Journals from IEEE and ACM is used to analyze and complete the research. [2]

Miguel Nussbaum is the author of “Educational Games and the Design Based Research Approach”, published in 2015 at IEEE 15th International Conference on Advanced Learning Technologies. It is an extended Abstract paper focusing on the research of Educational Games & the design-based research approach. It elaborates further the way how educational games should be structured and designed to increase engagement with the learner and to maintain a firm balance between the game elements & educational elements. As per what we learnt from the paper, the first thing to establish for an educational game, is the curriculum content to be covered by it, and to express it across the game with various Time & Difficulty level complexities. To establish the characteristics of the game that are fundamental and allow leaning in a fun way. The moment of fun must therefore become blurred with the moment of learning. [3]

Gary Hookway, Prof. Qasim Mehdi, Dr. Tom Hartley, Nsikak Bassej are the authors of “Learning Physics Through Computer Games”, published at the 18th International Conference on Computer Games aiming to provide an alternative for physics education in a format that appeals to users. Its main focus was on a specific field of study, Physics, which enabled us to understand how to and what sort of content should be focused on in a subject while keeping the essence of the subject during the gamification process. They released a series of short games on Physics education to supplement the traditional teaching methods. The paper concluded suggesting the idea of Gamification for educational purpose is viable enough to apply it to various other area of subjects. [4]

3. PROPOSED SYSTEM

As shown in Figure 1, TechGame UI is designed for the user to select mode (Easy/Medium/Hard) for specific subject of interest.

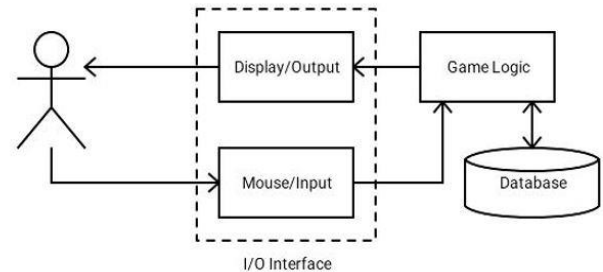


Figure 2: System Architecture

Based on Figure 2, the inputs by User define the gameplay and its working. The system architecture is expressed while designing the UI in Unity 3D with the use of Buttons & theme-based designing. With TechGame, we are aiming to make it easy and fun understanding the basic syllabus concepts in a form of MCQ pattern test, wherein the User, once start the game will get questions displayed one after the other, and will have to look for and shoot the Aircraft with the right answer. Each mode consists of a set of 10 questions on the chosen subject. A report with Correct answers and the Score will be displayed once the user attempts all the questions, as tried to explained in the Figure 3 below.

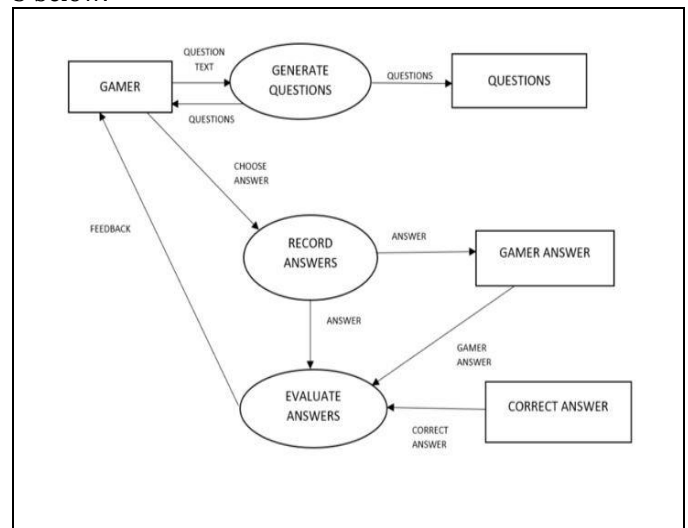


Figure 3: Data Flow Diagram

4. METHODOLOGY

In order to convert our theory on paper to real-time game application, the methodology was to make the best use of available resources like Unity blended with AR with the help of C# scripts. Below is the Use Case Diagram (Figure 4) based on Figure 3.

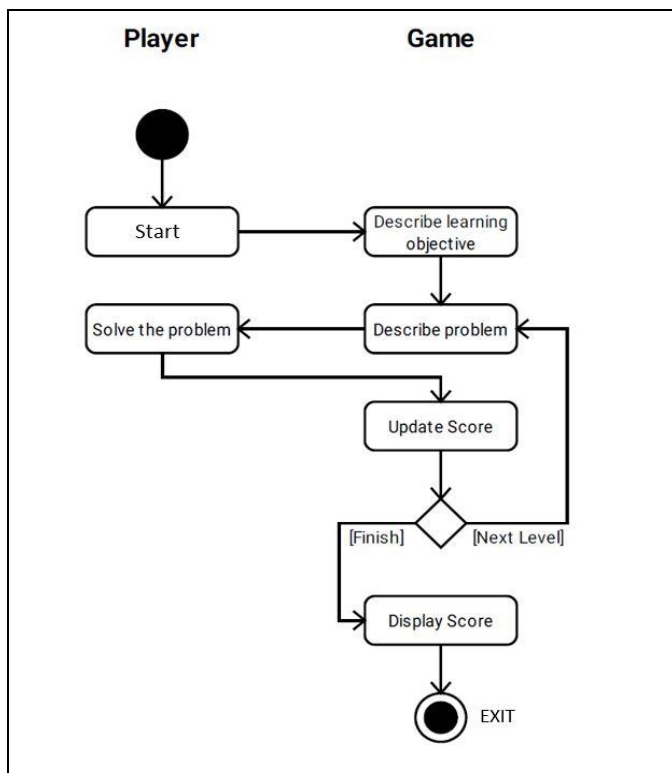


Figure 4: Use Case Diagram



Figure 5: Realtime Gameplay

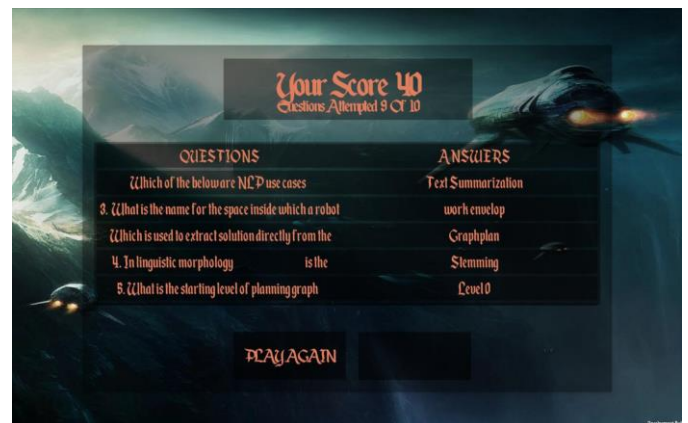


Figure 6: Gameplay Report Implementation

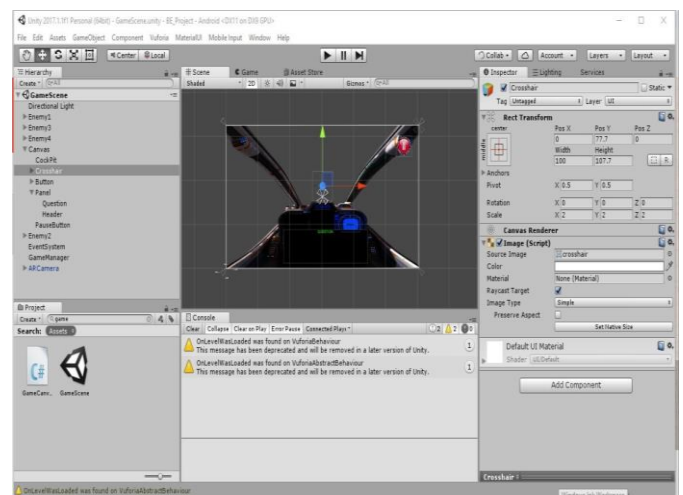
Unity being our development platform, C# Scripts are used for the data input and scripting sections. Implementation of which showcasing the real-time gameplay (Output) of TechGame can be seen in Figure 5.

With the help of various libraries and features of Unity 3D, the UI is designed with a Space War theme using Aircraft models with a Fire button to shoot and select the correct answer out of 4 options that can be seen on the screen, which is an AR interface using the Mobile Camera allowing it to be a real-world experience. This idea can further be tried and implemented for specific Virtual Reality (VR) devices to enhance the User experience and make it more interactive.

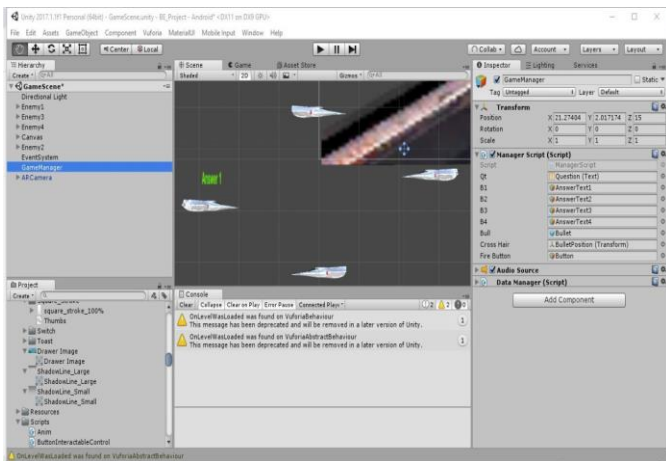
Figure 6 below showcases the final part of the gameplay, the Score report displayed once the user has finished attempting a specific set of questions in a mode.

Many more possible tweaks and innovations that can be done with our project are further elaborated while concluding the paper with Future works.

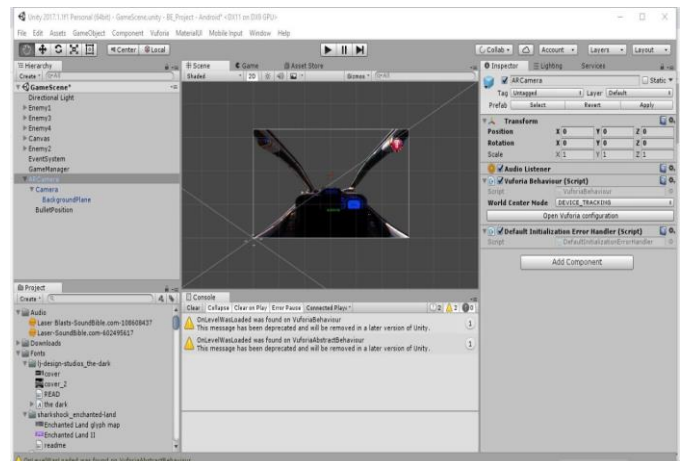
5. IMPLEMENTATION SNIPPETS



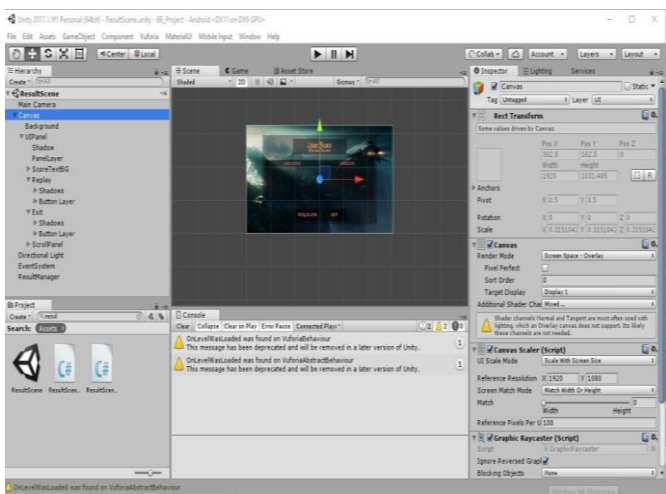
Snip 1 : AIRCRAFT



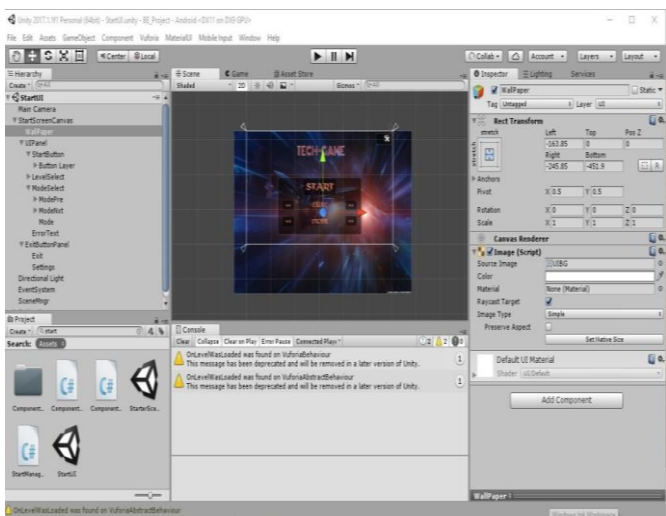
Snip 2 : ANSWERS



Snip 5 : AR CAMERA



Snip 3 : SCORE CARD



Snip 4 : STARTUP PAGE

6. CONCLUSION & FUTURE WORK

To conclude, the main aim of this paper is to make learning/studying fun and in a lovable manner for students by developing an Android Augmented reality (AR) gameplay covering the short and important syllabus questions. We've tried to identify and analyze the correlation between Game based approach and educational knowledge. The prototype provides elements of fun & challenge with the theme of the game, Space shooting scenario.

Providing education in an appealing way can be difficult [4], but that's what we have tried to ease by putting in options to choose the Subjects, Level of Difficulty w.r.t. Time Complexity and difficulty of questions. The User Interface is kept to the simplest of its form.

We hope the results showcased with the help of screenshots provide an overview about our vision of the game-based approach in educational sector for students, educators, and researchers in Education and also encourage researchers to develop software focusing on the game-based approach for Education.

For Future work, our app can be modified to a more personalized learning application by providing the end user in-depth analysis of their results, with correct answers and their justified explanations. Server-side database can be introduced to enable the feature of User Profile with Login details for maintaining the user data and game data. This data can also be used to create a sense of competition by introducing Leaderboard feature when connected to internet. This Augmented Reality version can also be tried to convert & implement it on a Virtual Reality device to enhance User Experience and make it more Interactive. Lastly, the scope of this work could be stretched by targeting the audience at different age groups such as primary & secondary school students.

ACKNOWLEDGEMENT

We take this chance to express our gratitude and Thank our project guide & mentor, Dr. Ekta Upadhyay for her continuous efforts to motivate & keep the game spirit on for us to focus on our project goal and think creatively amid the ongoing Pandemic situation.

It's owing to her expertise and the guidance she gave us, the encouragement and her whole-hearted co-operation and support, because of which we came this far in thinking off the grid and try to get an optimal solution.

We also want to Thank two of our fellow batchmates, Amit Luhar & Bharat Nisar, who guided us in using the Unity 3D for development and helping us to identify some unrecognizable errors at the time of deployment of the app.

REFERENCES

- [1] Lavina Nagpal, Meghna Jaglan, Anuraj Kathait, Aakil Mathur, Abhishek Vichare, "SOUL: Simulation of Objects in Unity for Learning", 2019 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT), Manipal University Jaipur.
<https://ieeexplore.ieee.org/document/8968786>
- [2] Mauricio R A Souza, Lucas Veado, Renata Teles Moreira, Eduardo Figueiredo, Heitor Costa, "Games for Learning", 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track.
<https://ieeexplore.ieee.org/document/7964342>
- [3] Miguel Nussbaum, "Educational Games and the Design Based Research Approach", 2015 IEEE 15th International Conference on Advanced Learning Technologies.
<https://ieeexplore.ieee.org/document/7265244>
- [4] Gary Hookway, Prof. Qasim Mehdi, Dr. Tom Hartley, Nsikak Bassey, "Learning Physics Through Computer Games", The 18th International Conference on Computer Games.
<https://ieeexplore.ieee.org/document/6632617>
- [5] Guoli Wu, Ming Qiu, Yankun Zhang, Yuhui Zheng, "Research and Development of Augmented Reality Children's Puzzle Game Based on Vuforia", The 14th International Conference on Computer Science & Education (ICCSE 2019), Software School, Xiamen University, Xiamen, China.
- [6] Chien-Hung Lai, "A Study on Applying Game-Based Learning to Cooperative Learning", 2012 Third

International Conference on Education and sports Education.

https://www.researchgate.net/publication/259609157_A_Study_on_Applying_Game-Based_Learning_to_Cooperative_Learning

- [7] BYJU'S - <https://byjus.com/>
- [8] WhiteHat Jr - <https://www.whitehatjr.com/>
- [9] UpGrad - <https://www.upgrad.com/>
- [10] Kahoot - <https://kahoot.com/>
- [11] Mentimeter - <https://www.mentimeter.com/>