



MASTER GENIE -AN AI CONVERSATIONAL CHAT BOT GAME BASED LEARNING

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Abstract: The technologies like virtual reality and artificial intelligence are popular across in gaming industry and as well as game based and web based learning. Game based learning is the latest direction in education because of the consumption of computer and mobile games of younger generation it is the relevant trend in education now. In the simulated environment the user can interact with different 3D objects to learn the real time activities and collaborate artificial intelligence make the learning more suitable. Master Genie is an AI chatbot assisted virtual game. The paper propose a cooking guide a tutor chatbot and a companion called genie to interact with the user and help them to enjoy and learn the cooking and make them believe they experience it in real. A VR game accessories involves VR glass and hand controller. The game develops communication skill and also improves language by providing a conversational ai in it. The paper focus on providing a preliminary knowledge on cooking and kitchen tools through a conversational AI chat-bot and real time experience with virtual reality

Index Terms—game based learning, 3D environment, artificial intelligence.

I. INTRODUCTION

Technologies and its upcoming trend is receive significance in modern world, following these technology educational system also lend new techniques to improve the efficiency in learning. From a very younger aged on to older one every individuals like learning by solving challenges and trying new methods here comes game based learning. It allows students of all ages to learn the real time experiences in better way by providing the necessary tools they require and issues valuable services. Generally a game based learning is developed by embedding game characteristics and principles within learning activities. Here, learning activities promote student engagement and motivation to learn. By emerging virtual reality in game based learning increase the potential of student education by interacting virtually rich objects containing environment. Virtual reality in game based learning steadily increased interest of students and can provide 3D real-life synthetic environments in which controllers allow human interaction.

II. RELATED WORK

The blending of virtual reality and artificial intelligence for game based learning [1] and [2] has emerged a new focus of research in many fields like industrial, medical, education and so on. Ever since we began to realize the potential benefits of these technologies which they are always overthrow the difficulties in many fields and build a calm and uncomplicated. It is incredible that VR together with AI can educate the next generation of professionals in life threatening and high risk jobs. [1] a VR escape room game in which it provide a virtual reality escape room game for the user to leveling up the skill. A normal escape room game sometimes cant unlock and found by completing puzzle .So here the paper propose to create an environment that have varieties of cultures of different countries that help the player to interact with and puzzle solving challenges to solve to escape from each rooms in the game. The challenges are like math, arrangement, and pattern recognition. The paper focus to gather data about the significance of VR games. And the goal of this project is use the free time of player for developing skills. The game also propose a different method from other relevant VR escape room games that it use teleportation to enter the next stage of room without walking so this method helps the player from VR sickness and reduce complexity it is the unique feature of this game. Also the game intent to use free time of user efficiently to bettering up the skills like solving puzzles, math, arrangement, and pattern recognition which followed by a good background story with culture and tradition of different countries and it help the player to develop skills in problem solving, critical thinking, cognitive skills, and also the game sharpen their concentration. Here it have a limitation is that it is compatible with HTC vive gear only but this limitation is not that much crucial. In this paper [2] it design and implement a virtual reality kitchen which have an embodiment agent to perform cooking which is teach and trained by the creator and also there is an evaluation benchmark and data collection tools. The system have two sets of real time cooking task that is we commonly use tools and preparing dishes in a virtual kitchen VR kitchen. And task learning with sample procedures. The game also proposes a new challenge that is VR chef challenge for providing a standardized evaluation for noticing different approaches in terms of their learning efficiency in complex 3D environments. It implements a wide range of 3D virtual kitchen environment which allow physical simulation with object state changes and compositional goals. Includes a tool

kit VR based user interface for collecting human demonstrations and API for training and testing the AI algorithm in virtual reality environment. A human demonstration data set of various cooking task .training and teaching the AI agent with the help virtual reality device human users serves as teachers for the agents by providing demonstrations in the virtual environment. Here the system builds agents in human like appearance and detailed embodiment representation. The system have limitation like it is time consuming and already trained things will done and we can partially cope up with this limitations.

This paper propose [3] an AI agent feature to support a VR serious game.it introduces a pedagogical game agent which means this agent is designed for interacting students and user. Here it is also entrusted with the role of a motivator the state of the game is built in PGA pedagogical structure. During the progress of the game and monitors through virtual objects they assistance both on the individual level to each student on team level to each team of student. Next is the AI chatbot they provide useful information about the game rules to user and they are designed in human like avatars. Students communicate with the chatbot by using a private text chat sent questions to them and get personalized response. For the implementation of chatbot AIML artificial intelligence markup language is used. And next is the progress map which is used to show the achieved progress of each team it operates collaboratively and was implemented as head up display. By these following features the game aims to explore that by this AI features in game based learning in education can affect in students attitude and behavior towards the learning and educational game. The intelligent game environment increases concentration in classroom after completion of this game they become more active in helping, supporting and become connected to each other. The game propose to provide collaborative educational procedure by the support of intelligent interfaces. The agent and additional features were designed for playing some specific roles in game like motivator, navigator, collaborative assistant game facilitator and to transform the game space into a virtual learning environment. There is some limitations in this system like limited time or an immersive 3D environment results anxiety in students and affect students attention leading them to ignore or to be annoyed by the presence of an agent.

[4] This paper propose a scripting model for training the virtual environment by combining a pedagogical control and the emergence of relevant learning situations and tracks the learners actions. The system enable the user to learn about the virtual environment and learn from their errors without constraints or activity guidance. The system allows dynamically control the learning and the total consistency of the environment. Here the system propose a learner tracking by using plan recognition technique which finalized the activity that mainly contains the observations of situation the compromises made by the operators and frequently occurring errors. Based on the reference model in the system which allows to determine the task performed by the user committed errors from observable actions which left in the virtual environment . In return for that the system script the virtual environment on the contextual rules and on two calculated parameters like complexity and sensitivity. The game observing the virtual environment contained observable actions or affect and it send a message for tracking and scripting system. Here the system uses a task recognition technique were it determines the effective task and committed errors. Then it analyze the determined feedbacks, performance, complexity and severity based on the contextual rules and pedagogical set. At last it trace the record in xml form. It is less efficient because of no better training[5] The paper implements a spoken conversational interface for making social interactions. The system is designed to notice and record the time taken by the user and keep them engage with the game character. And then evaluate the emotional detection and response in spoken dialogue. Here the system uses sentimental and emotional analysis for giving the user a better outcome. The conversational AI is split into three components first is the unity engine which handles the prototype he input is taken from the Automated Speech Recognition(ASR) unity creates a VR background where player can control the character like looking and walk around in the environment. Next is speech recognition here system use Microsoft windows speech and also cortana a window 10 built in assistant which is unity compatible. Speech recognition is done by in terms of turns of dialogue there is no interruption happen when the NPC is talking. And there is a microphone given in the side bar with is allowed to use when this NPC stops talkingallow user to interact. And the icon placed in the left corner of screen indicates green and red in times of speaking when to start. Next component is IBM Watson it is a cloud service for tone analysis on the text. This module handles the response audio synthesis via IBM Watson text to speech after the processing a response by the dialogue manager it sent to IBM Watson text to speech service the audio file is return to and played in unity game. Next is conversational AI here the system uses a modified version of Alana system. Here user can freely talk with AI using an unconstrained speech input..five years. Using 3D objects to make more interested and richness in virtual reality there is some important things to consider collision detection is one of those things.

[6] in this paper it implement a virtual museum where user can interact with certain objects, such as museum door, manuscript, and lift. The system is enhanced with animated object. Also add up a collision detection mechanism to prevent avatar from penetrating objects. The advantage of virtual museum is that the museum visitors can see the collection from internet. It uses an interactive whiteboard that has a special whiteboard marker as the input device the man objective of this paper to make the virtual museum which enables virtual interaction with object and implement collision detection on every wall. Here in this system works creating a virtual reality application which creates a mirror image of museum. Here system implement a collision detect to avoid the possibility that the user emerge through the virtual wall thus user can walk freely in the virtual museum. The collision prevention is an important issue in 3Dgraphics.Here the system use detection algorithm having two steps. First step used to detect the collision of avatar wit wall. If collision happen it give response as it backing avatar to nearest position. The application was tested by ten users and they satisfied with the interaction of simulated objects and result of collision detection. Speech recognition has become an integral part of human computer interface they are present in Google assistant, Microsoft cortona, and so on. The speech command models which are able to recognize a single words start, stop, left etc. And recurrent neural networks work best for speech recognition. [7] this paper is to study about recurrent neural networks and there performance and also the use of RNN by famous speech to text conversational engines. Speech recognition is also said as computer speech recognition because which making the computer understandable. Speech recognition consist of microphone for user to speak, recognition of speech software and a computer to perform the task. First an audio is given as input to process then it feed to deep neural network after feeding small audio to network then it will figure out the letter which matches the spoken sound. The RNN it has a memory that decides the future predictions. The commonly used RNN is long short term memory LSTM it consist of four structure and main element is cell state using gates it add or remove any information as required. Here it have 3 gates that are

input, output, and forget gates. These gates are generally used to protect or control cell state. RNN is the best training algorithm for speech recognition but training algorithm is again very complex and it have better result than multilayer perceptron.

III. REQUIREMENT ANALYSIS

3.1 Unity3D Engine

Unity is the real time game development platform, this is one of the most advanced tools out there for game development along with Unreal Engine, Cryo Engine and others. The Specialty about unity is, it is a cluster development engine it can develop a really advance game alone without having need of any external requirement. Unity is a cross platform game development engine which is developed by Unity Technologies it was first introduced to work in June 2005 at Apple's worldwide developer conference. In 2018 the unity started supporting more than 25 platforms. The engine can be use=d for creating 2d and 3d games with VR and AR support, as well as simulations and multiple other experiences. The engine has been adopted by multiple industries not just video games but as film studios, automotive, architecture, construction and engineering.

3.2 Tiled Map Editor

Tiled map editor is a classic level editing tool been in development since 1st sept 2009 its been in level designing industries from a long time where it is public funded project it's been a popular project among game developers from a long time, because of its handy drag and drop design its possible for it to make Orthogonal, Isometric, Staggered, and Hexagonal very easily and efficiently. Types of maps it is a 2d map editor which makes it ideal map editor for this project.

3.3 Super Tiled2Unity

SuperTiled2Unity is a library for communication between Tiled and Unity it is a library which is written in C# code so It could translate Tiled's TMX & TSX files which are basically XMLs to unity's Tile Map Integrity which gives you a dynamic interface for your levels and lets you dynamically bend the rules of the maps according to your needs.

3.4 C# Programming Language

C# Programming language was developed by Microsoft in 2000 for as a part of its .NET initiative and after that it was approved as an International Standard by ECMA-334 in 2002 and also ISO/IEC 23270 in period of 2003. It is Multi- Paradigm programming language encompassing static typing. Unity uses C# as it's operating language in a scripting style where it can be operated/used/tweaked or developed by it.

3.5 Google Firebase

Firebase is a platform developed by google for development of Mobile and web app, firebase majorly focuses on Serverless app development where it provides multiple services such as:

- Google Auth
- Realtime Database
- Firestore Database
- Google Analytics
- Crashanlytics
- Cloud Messaging
- Cloud Storage
- Google Cloud Functions

And many more services to make your work efficient and as serverless as possible even though some of the services are paid but google provides enough services for a small efficient project.

3.6 Google Sign-In API

It is a Google Sign-In API Plugin for Unity Engine which supports Android and iOS this plugin gives an exposure to Google Sign-In API inside unity. This plugin is specifically developed for unity which requires OAuth ID tokens or server auth codes. This project uses google sign in for the authentication and this plugin developed by Google makes it possible.

IV. PROPOSED METHODOLOGY

The proposed system to save the most efforts possible focuses on least game designing and most auto-generating levels. Basically, there are 3 levels in this game's architecture where the first one focuses on resource development in this project ill be going with hyper-casual game methodology where the game doesn't require any story but some random generating maps and hurdles to generate a whole new experience on each and every attempt,

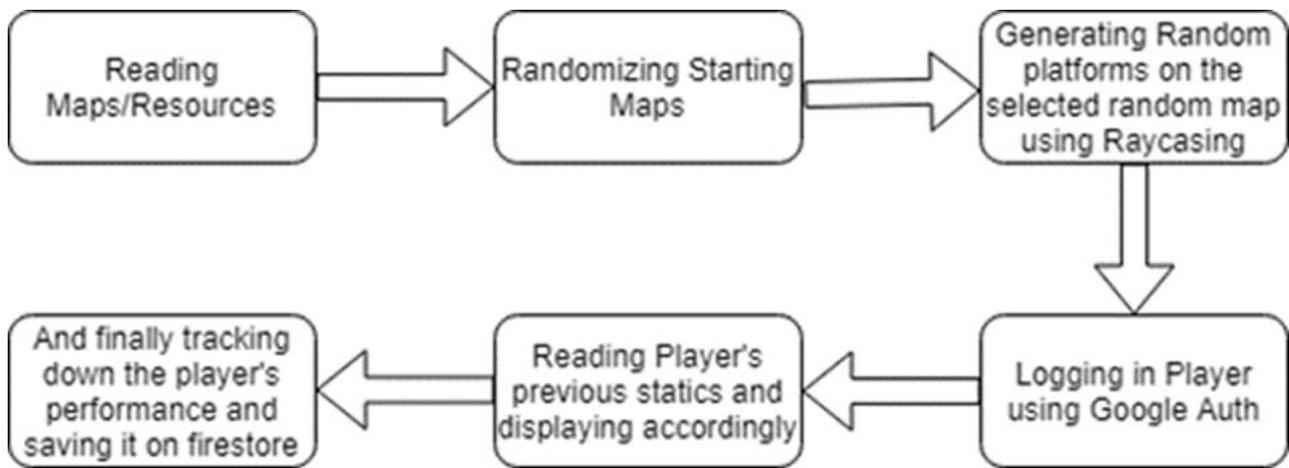


Figure-1: Workflow of the proposed system

The Figure-1 shows the base work flow of the external structure how game is created and loaded. The idea is to develop a game with using total auto-generated maps and levels and most of the things possible without having a need of any level designer/game designer there are few criteria to be fulfilled which are as follows:

1. Reading the all maps as game object and saving them for further usage.
2. Loading the map into the game scene and casting a ray on every tile size to check if a tile exists on the position in this case it is 128x128.
3. Getting the empty positions.
4. Generating platforms on empty positions by using an array of sprites which are loaded in the first criteria.
5. Generate next map position it at exactly below the current map so it creates an illusion of forever running platformer.
6. Generate enemies on the randomized rate as well on every platform.
7. And destroy previous map sequentially on every map's exit.

4.1 Game Resource Loader

Game resource loader or game asset loader is an separate script which loads whole game assets on game startup and gives all the resources I need accordingly. Unity have its own resource folder manager which loads all the resources **from the** resource folder all I need to give an URI and it directly loads the resources its an external part to improve the overall performance of the game and so it doesn't load the resources in-between gameplay.

4.2 Game Map Manager

Game Map Manager works on a algorithm with a collaboration of unity Game Object Triggers.



Figure-2: Game Map Manager Structure

Game Map Manager tracks every map's edges when player exits previous map current next map is set to current map and current map is set to previous map so it creates a cycle of forever running maps sequentially, and on every exit from current map the previous is destroyed to save the object memory.

4.3 Game Platform generator

Game platform generator works with Unity's Physics Ray Cast and random numbers, Unity's physics ray cast casts a ray on every single tile of the map then it gives a output if a ray hits the map object if it doesn't hits the object the X,Y points of the position of that ray cast adds to a list lets call it $K = \{p_1, p_2, p_3, \dots, p_n\}$ where k is a list which contains points p of every empty tile per row.

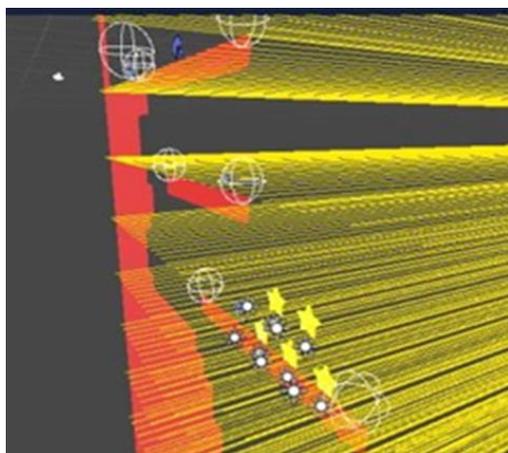


Figure-5: Tracking of empty spaces by Physics Ray Casting on Game map

Once we have the whole generated list of the empty spaces in map we generate the platforms row wise and according to empty space I decide how long should the platform be, algorithm generates a platform size from p1 size to pn-2 totally randomized size it could select any number in between negative 2 because so it doesn't the cover the whole path. So, each tile size of 128x128 generates the platform with p1 and pn being the edges of platform. Now, with the edges I put 2 game object points for Enemy Patrolling and I generate the enemy in center of the platform by Platform Width/2 position and that's the work of platform generation.

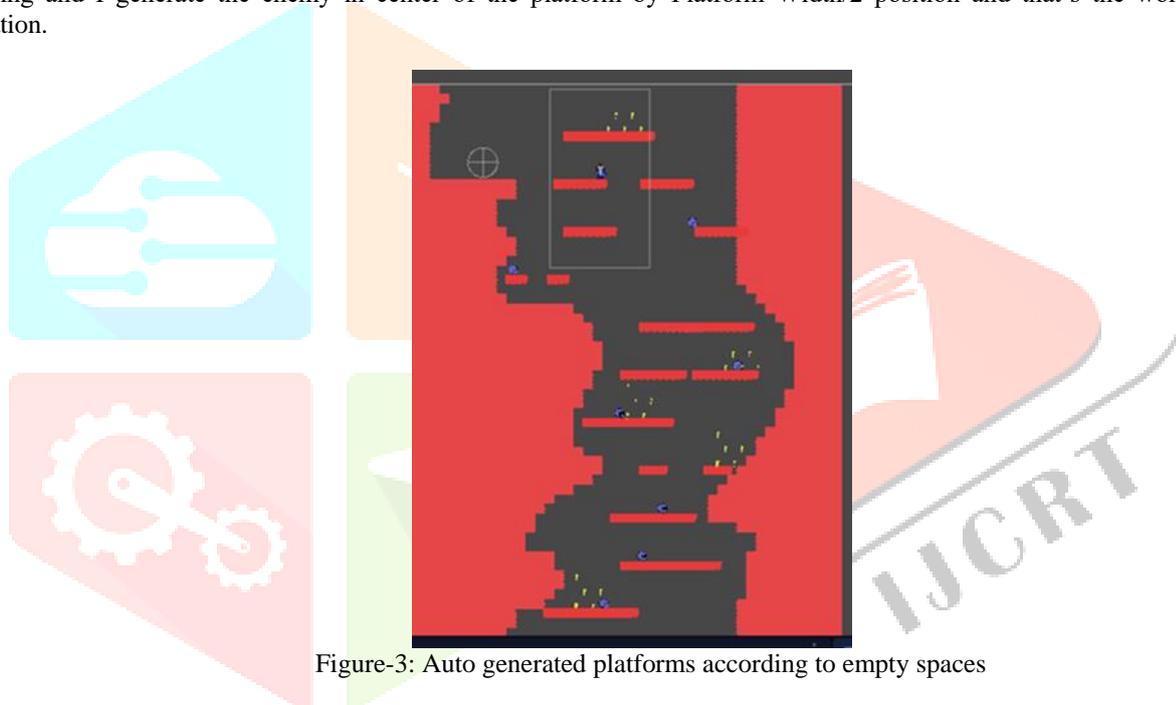


Figure-3: Auto generated platforms according to empty spaces

4.4 Firebase Initializer

The Firebase initializer, initialize firebase services which includes as follows:

1. Google Analytics: Google Analytics gives a precise statistic on users who are using this app on their phone including Time usage, Region, Last login, crash free users and even user loss.

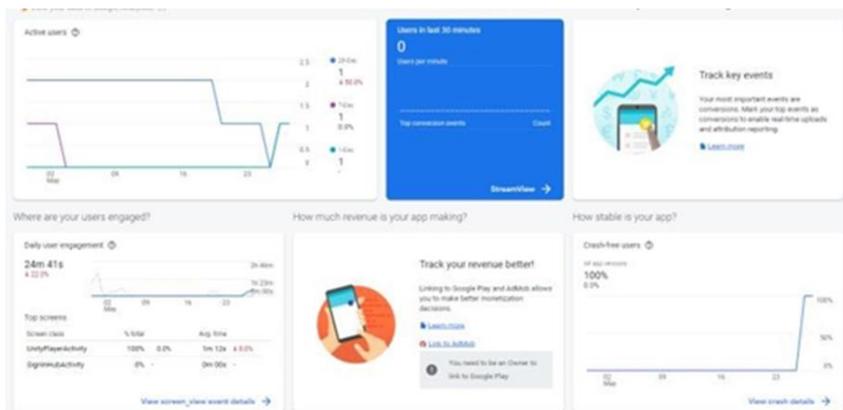


Figure-4: A display of google analytics showing some recent usages of app and some user loss

2. Google Firestore: Google Firestore gives me a direct easy access to google database there's another database which is real time database which could be used to make games because of its low latency, this project does not include an multiplayer version so, it has just implementation of googlefirestore to store the high score values and recent score values. I have written a whole API which has prebuilt queries to documents directly and the message is sent by single method, a total recent score and high score message is sent and it is saved to firestore as well in a separate document. Where each user's id is saved as its unique email id retrieved by google sign in.

3. Google Cloud Functions: cloud functions are used to implement backend services, in this project cloud functions are used to verify database inputs when a value is passed from the client to firestore through Firebase API cloud function check the value of high score if its greater then it supposed to be it doesn't save the value in firebase at all the game sends the high score to firebase in every 10 seconds in every 10 seconds max value of the high score should be 50 for safe side I have taken max value of 100 if its greater then that it is not stored in firebase at all.

4. Firebase Authentication: In this project it is made sure that any value coming to firebase from the client is from authorized user any kind of value which is coming from outside suppose a man in middle attack will not be used or considered, client has a web key after login google firebase generate an authorization token which is sent to firebase it is auto encrypted and used by firebase itself which makes it safe and reliable for development of apps.

The whole firebase is used as BaaS or Back-end as a service which means the firebase handles the whole backend hosting and additional services which doesn't require this project to hire/handle any additional server all the work is done by some implementation of programs and queries.

V. IMPLEMENTATION

The game's ideology is basically, to generate whole game by lowest efforts possible without requiring any level designer or any kind of strategic story development. This project is majorly focused on hyper-casual game concept which is basically leads to Non-Story focused game, a game which could be played for infinite amount of time and that concept is also most famous of additions there are multiple examples of games like this and some of them has taken over the whole gaming industry. and managing all the back end work by google firebase services without developing and hosting any server.

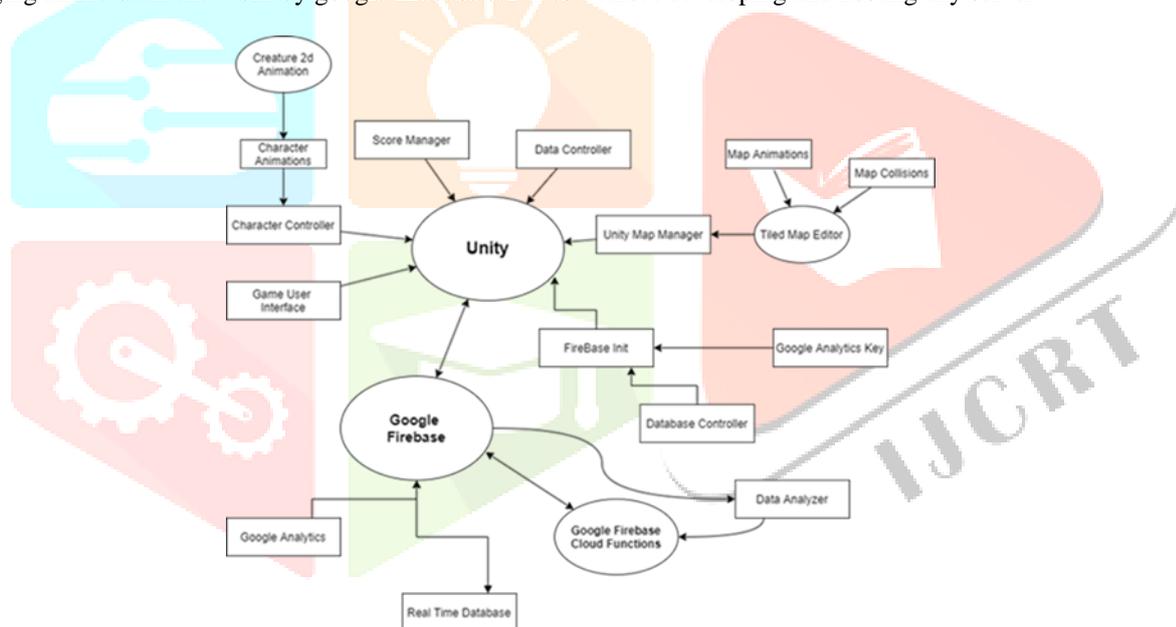
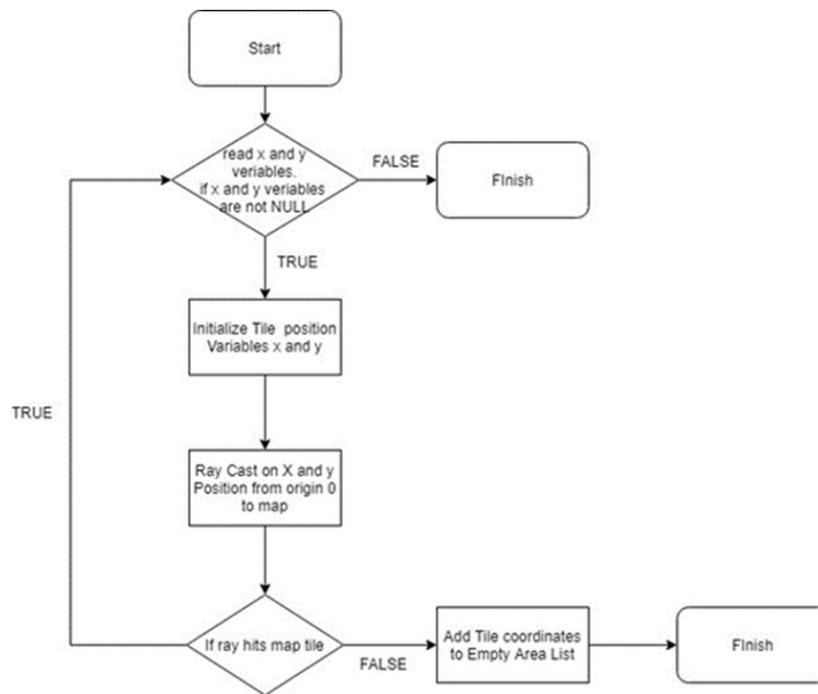


Figure-6: A display of whole project's flow and structure, showing how the different services are connected together with Google Firestore and Unity

5.1 Game Client

- Resources Management: - there are various kind of resources which can be made/managed by the same programmer or developer the maps are made in Tiled by simple drag and drop system with using some sprite sheets or also called tile sets, then there game character, enemy character, music, game currency tokens and all the unity prefabs used in this project.
- Map Loader: - the whole map generating/loading is managed by SuperTiled2Unity which loads the whole map as prefab game object this map is directly dragged and dropped into the game scene first map is placed directly to implement spawn point and main character.
- Platform Generation: - Platforms is generated by detecting empty areas with ray cast algorithm used in this generation is pretty standard by detecting every single area with ray cast.



This is the working for generation of empty area list, this list of empty area inside of tiled map is used to generate platform size and platform itself.

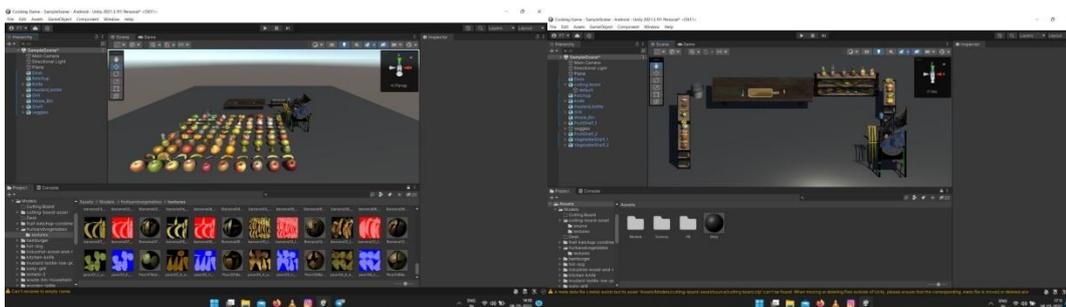
- Enemy Generator: Enemy generation is based with platform generator with platform size randomization enemy is generated by random rate as well right now in this project enemy is generated on every platform with rate of 40% and there's 2 patrolling points or empty game objects for transform positions to use enemy patrol around the platform. And the enemy is generated at the middle point of platform so its ($x = \text{PlatformWidth}/2$ and $y = -\text{PlatformHeight}$).
- Token Generation: - Tokens or Game points or game currency is generated with 3 different patters with a same method as enemy random generations with the rate of 50% they are randomly generated on every platform by using same method as enemies.

5.2 Game Back-end

- FirebaseInit: - Firebase Init is a service which runs on the main thread of the game it is used to initialize firebase in the unity game
- FirestoreAPI: - Firestore API is used to send and receive messages from the firebase in this project there are multiple queries which in this project are pre-made for repeatable usage.
- Google Analytics: - Google analytics grant me ability to track my app user's statistic like country region, usage time, etc.

VI. RESULT AND ANALYSIS

There have been so many challenges and making difficulties of a complete virtual reality. Fabricating a whole 3D environment from a scratch is a very time consuming one. People who don't have that much knowledge in designing and gaming face far more difficulties. Here the system provides all proposed needs efficiently. The AI chatbot helps to enquire the queries and helps the user to learn about kitchen tools and ingredients are going nicely. First, an initial analysis was conducted on pre-test acenarios to ensure that there were no problems in cooking and ensure proper guidance of the chatbot. A 0.05 level of significance was used for the statistical test. Results indicated that the chatbot can efficiently solve the user queries and response in a few seconds. And also the user can maintain a conversation with the chatbot while they cooking. By the test we can blindly tell it improves communication skill to an extend. Finally, descriptive statistics of additional intelligent features and semi-structured interviews were utilized to shape some insight on the user's experience during the game and identify issues needed to be improved in future work.



VII. CONCLUSION

The system propose a game based learning in fusion with an artificial conversational chatbot in a 3D environment. Implementing a 3D environment and creating a web app to provide a cooking experience to user. Introducing a conversational chatbot to the game for solving kitchen enquiries and giving proper solutions for user it makes the game more interesting. In future work we can introduce full immersive virtual reality into the game. VR gaming is the term used to describe a new generation of computer games with virtual reality (VR) technology that gives players a truly immersive, first-person perspective of game action. Participants both experience and influence the game environment through a variety of VR gaming devices and accessories, including VR headsets sensor-equipped gloves, hand controllers, and more. The paper focus on an interactive chatbot in a VR environment game. System helps the player in developing communication skills and improves language along with fun in cooking and using their free time. In addition to that it makes an interest in user of how to make a dish by giving a proper guidance.

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