

# [Villicity]



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# Celiac Disease and Empowerment: Can Gamification Increase Child's Empowerment Feeling and Adherence to Gluten Free Diet?

## **Abstract**

It is widely recognized that in celiac disease (CD), to learn and adhere to the gluten free diet (GFD) is essential for ensuring a good quality of life.

It is important that the education process adopt strategies to motivate and make the learning effective, particularly for children and adolescent. In this context, new technologies can help make the learning process more engaging.

The main idea is to use a game approach in order to make the learning and training process more engaging and intuitive. The goal of the game, Villicity, is to facilitate self-management skills in children aged between 7-13 years with CD. Specifically, the game will train young CD to self-manage their clinical conditions and especially to prevent unaware gluten ingestion events and enhancing their feeling of empowerment. In order to measure the learning effectiveness and the usability of the game, a pilot study was conducted with patients and unaffected children. In order to measure the effectiveness of the interactive game intervention to improve gluten free diet adherence, a prospective study with randomized controlled trials will be conducted. A total of 100 children with biopsy-confirmed CD will be recruited and randomized to receive the intervention (n = 50) or to a waitlist control condition (n = 50). Pre and post-intervention data will be collected in order to measure changes in CD knowledge, quality of life, parents reaction to possible changes in the child's management of the CD, and the child's feeling of empowerment.

## **Game Application**

We developed a 2D mobile game

The game consists of 3 games and each game consist of 4 levels.

In addition you have educational videos, leader's board for community motivation, daily challenge and more.

[Trailer Video](#)

[Game Website](#)

[Download Game here](#)

## Introduction (Tools)

We created a 2D mobile game that runs on Android platform.

Developed in Unity 5 - graphic engine, scripted with C# in Visual Studio and MonoDevelop environment.

**Unity** is a cross-platform game engine that is used to develop video games for PC, consoles, mobile devices and websites.

With an emphasis on portability, the engine targets the following APIs: Direct3D on Windows and Xbox 360; OpenGL on Mac, Linux, and Windows; OpenGL ES on Android and iOS; and proprietary APIs on video game consoles. Unity allows specification of texture compression and resolution settings for each platform that the game engine supports, and provides support for bump mapping, reflection mapping, parallax mapping, screen space ambient occlusion (SSAO), dynamic shadows using shadow maps, render-to-texture and full-screen post-processing effects.



**Firebase Server** is a mobile and web application platform with tools and infrastructure designed to help developers build high-quality apps.



# Features and Implementations

## ❖ Mobile Device Input

On mobile devices, the Input class offers access to touchscreen, accelerometer and geographical/location input.

Access to keyboard on mobile devices is provided via the iOS/Android keyboard.



## Multi-Touch Screen

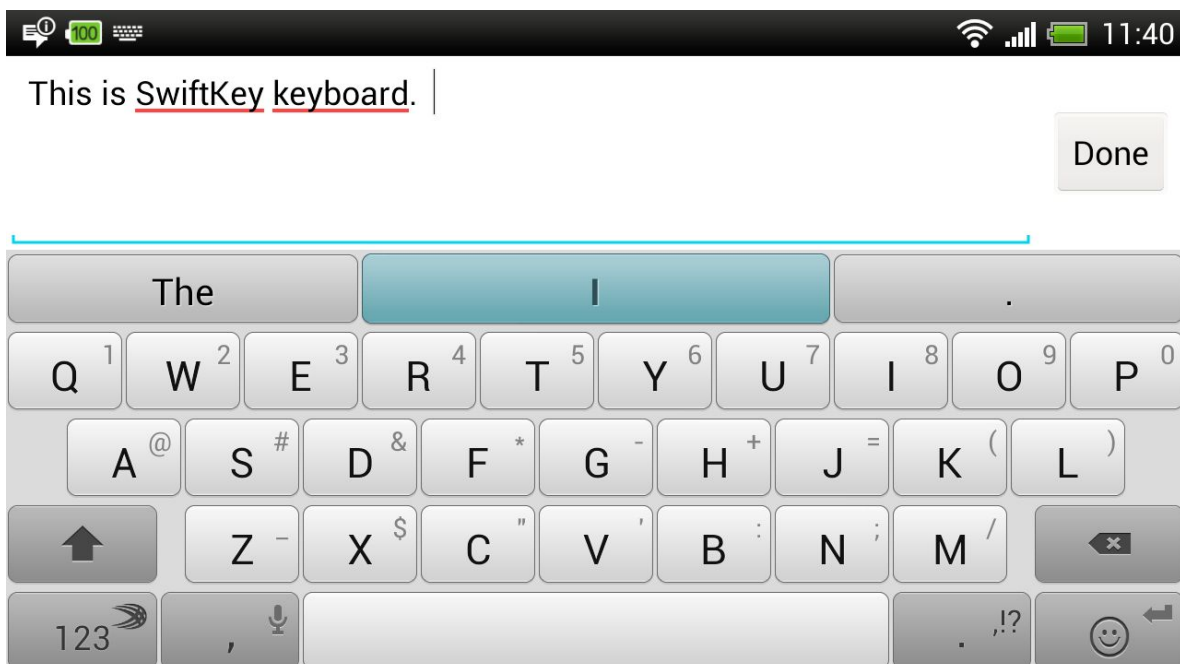
Android devices don't have a unified limit on how many fingers they track.

Instead, it varies from device to device and can be anything from two-touch on older devices to five fingers on some newer devices.

Each finger touch is represented by an Input.Touch data structure.

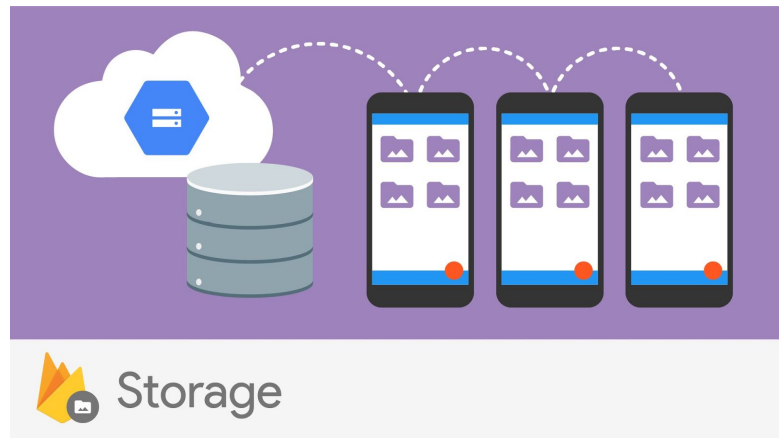
## Mobile Keyboard

The keyboard will appear automatically when a user taps on editable GUI elements. Currently, GUI.TextField, GUI.TextArea and GUI.PasswordField will display the keyboard.



## ❖ Log File

Firebase Storage adds Google security to file uploads and downloads for your Firebase apps, regardless of network quality. You can use it to store images, audio, video, or other user-generated content. Firebase Storage is backed by Google Cloud Storage.



In our app we developed a global function which update the cloud file after every relevant action e.g. entering a game, winning and gaining points, fill in the daily challenge and more...

We have one log for each user for every single time the user enter the game if the user didn't exit the game it will be updated to the same file that was created on the entrance.

(1) First by entering the "Storage" section

(2) You'll see all the stored loge files - with the relevant name(<date>\_<time>\_<username>)

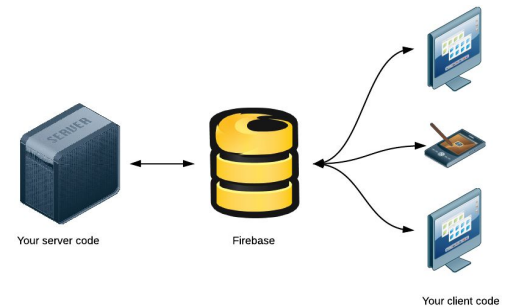
(3) By clicking "Download" you'll get a 'txt' file filled with all users actions in the application.

Name	Size	Type	Last modified
01.27.2017_18:28:34_design2.txt	611 B	application/octet-str...	Jan 27, 2017
1.29.2017_10:29:44 AM_dev.txt	334 B	application/octet-str...	Jan 29, 2017

```
10:29:44 AM:Villicity Game Started;username dev;maximum level 12;score 100
1.29.2017 10:30:43 AM;Leaders bored open;
1.29.2017 10:33:08 AM;Enter level 4;
1.29.2017 10:34:24 AM;Enter level 8;
1.29.2017 10:35:21 AM;Close level 8;Lose
1.29.2017 10:35:53 AM;Enter level 9;
1.29.2017 10:37:10 AM;Close level 9;Win;life 1;update score 140;
```

## ❖ Firebase Realtime Database

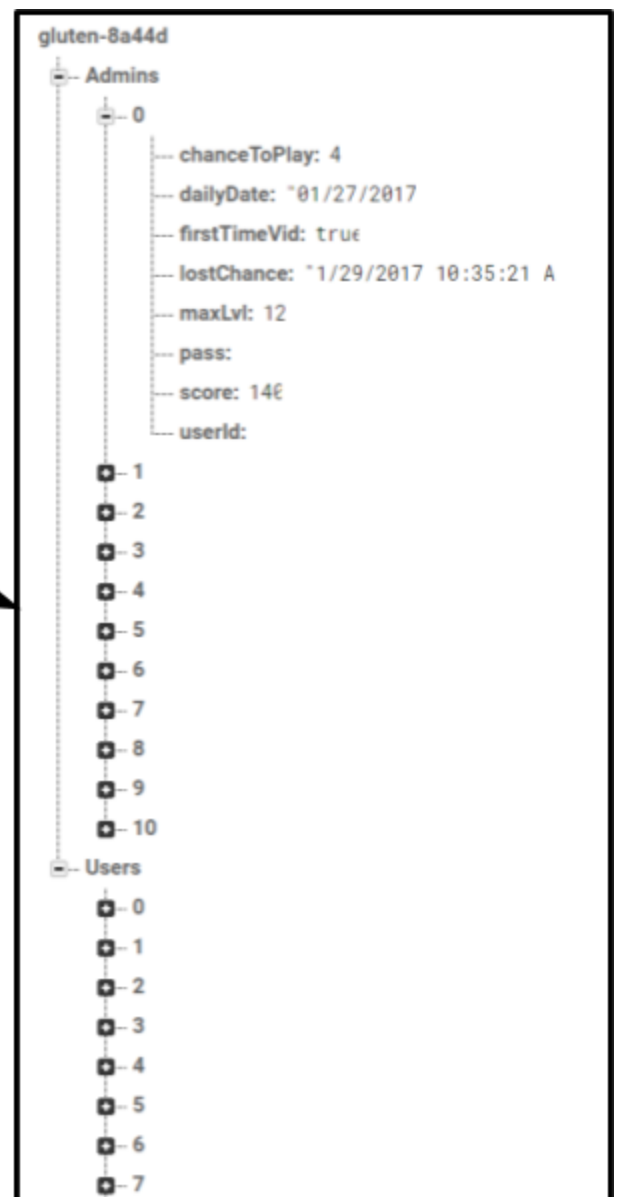
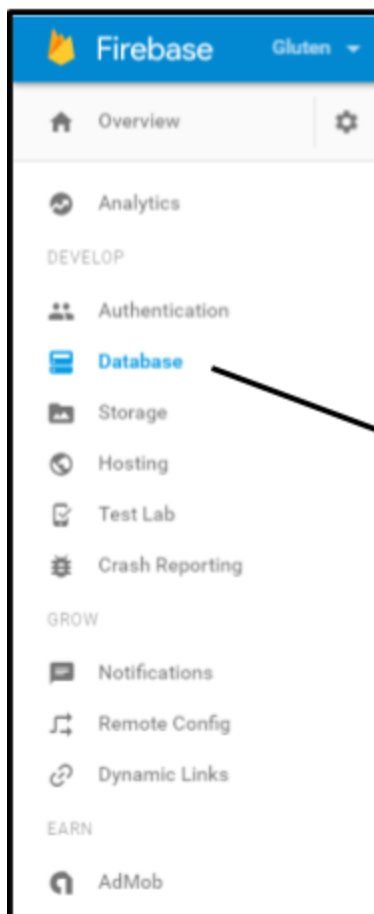
Firebase provides a realtime database and backend as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored on Firebase's cloud.



## User & Admin Script Manager

In our app we had a special script for managing the DataBase- to create Users and Admins with some difference in their game options.

In addition we wrote different separate scripts to support: login, leaders board, save user data and more..



## Scoring System

We created a special prefab called “level manager”.

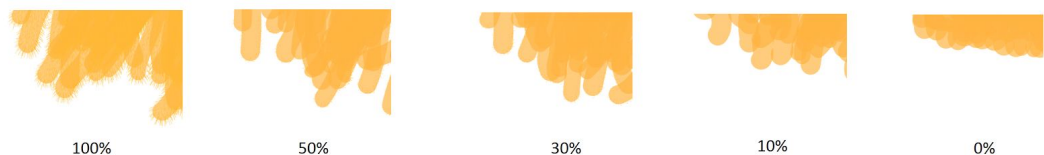
Prefab is a convenient way to build a GameObject in the scene by adding components and setting their properties to the appropriate values.

Fortunately, Unity has a Prefab asset type that allows you to store a GameObject with all its components and properties.

The prefab is like a template from which you can create new object instances in the scene.

Any edits made to a prefab asset are immediately reflected in all instances produced from it but you can also override components and settings for each instance individually.

The level manager is an object which contains script, that manage the states of life in the game, that means he counts the bad moves and the good moves in the game, calculating and updating your lives **\* \* \*** and villies states (by changing an Image object on the screen) accordingly.



After three “bad” moves the “level manager” stops the game and display “Game Over” popup, if the player succeeded to restore the villies in 100% the level manager stops the game and display a win popup and update the player score.

How It Works:

In every game the “level manager” is initialized with the level number and it calculates the number of frames to update in good or bad moves, when the player makes a move the number of the frame representing the state of the villy calculates and a function that invoked call to start “animation”, which is made by iterate over the frame picture every 0.1 seconds so that’s creates a picture animation with a recursive function calls.

## ❖ Popups

There is various of pop-ups in the game, which is preferable in most of the known game to have a popup instead of changing screen, so you can still see on the background all the relevant information for you.

### ➤ **Start game level**

Open a game level description and you can start the game if you have enough “play chance lives” otherwise you’ll have to wait at most 30 minutes to get an additional life to play.

### ➤ **Exit/Pause game level**

When in the game you can press the ‘X’ button which will pause the game immediately on press, afterwards you may continue the game or exit to the main menu screen.

### ➤ **Win/Lose**

On “gameover” or “winning” you’ll get the pop-up which is or inform you about your lost or will calculate the amount of points you gained.

Also there is 2 optional buttons to exit to the main menu screen or to restart the current level.

### ➤ **Exit game button**

Onclick will force close the application.



## ❖ Education Media

On first time you entering the game there is non optional education video is launched and you’ll have to watch it till the end(Video about Celiac disease).

On all your other logins the video will not start on entering which is managed via the firebase server.

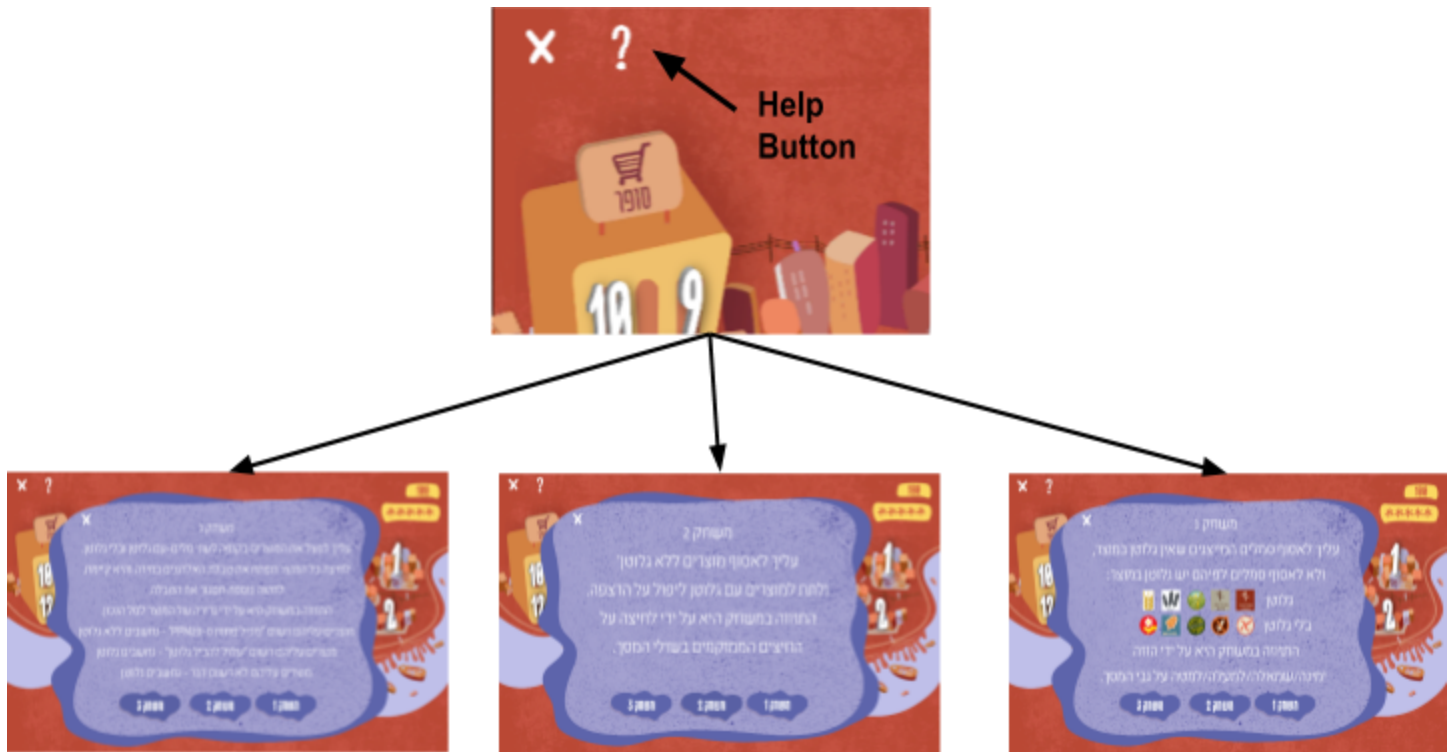
Then you’ll have a button to launch the video at any time you want and it’s popup with a navigation bar to jump forward or backward in the video itself.



## ❖ Help

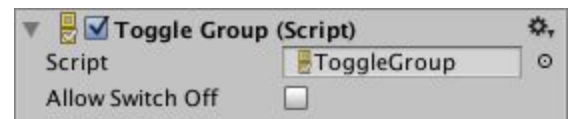
OnClick open a Help window with the game rules, which tells you what symbols to collect and what is consider with gluten or just checking you intuition to make some statistical analysis about the product you see.

Also have some explanation about the controller you use in your touch screen e.g. drag and drop, hold screen buttons or slide horizontally/vertically.



## Toggle Group

A Toggle Group is not a visible UI control but rather a way to modify the behavior of a set of



Toggles. Toggles that belong to the same group are constrained so that only one of them can be switched on at a time - pressing one of them to switch it on automatically switches the others off.

In the help window the buttons on the bottom of the popup are toggles and connected to the same group, so you can't turn on 2 of them at the same time(similar to checkbox implementation)



## [Login Screen]

On game start - we load all server data locally to the game and store it in a dictionary contains key(username) and value(password).

After the user insert the username and password and click the login button we check if the dictionary in the specified username location match the provided password.

If it match we load all current user data and continue to the main screen of the game.

Otherwise we throw an "Access Denied" message.

All user important data of his last save are loading to the game including, his maximum game level, score and more...

Different level of privilege are granted to Admin or simple User, which is also recognize while the first login screen process.



## [Main Menu]

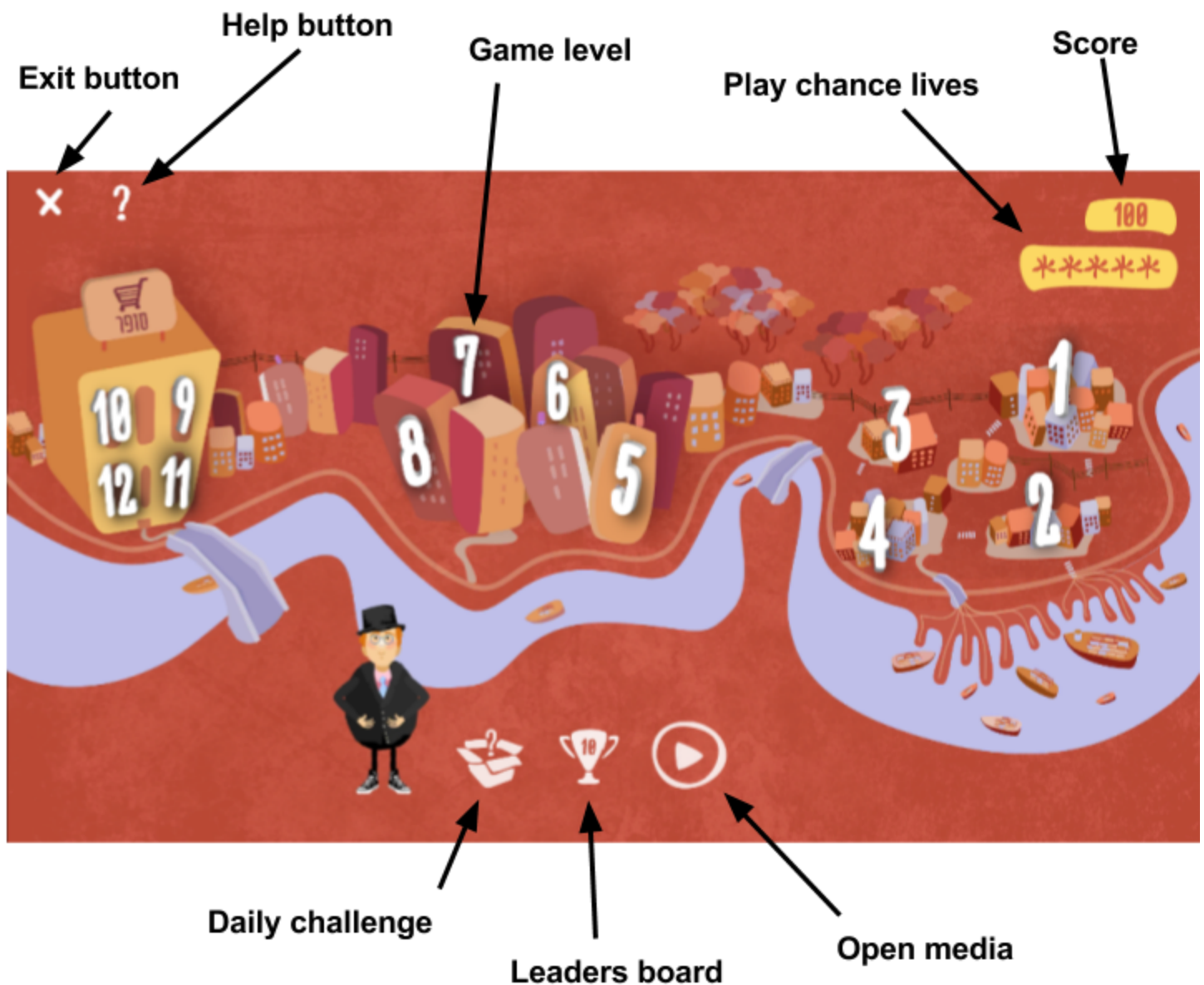
The main menu screen is the screen you always see between the games and can lead you to any screen you want.

It consist of 12 levels which is 3 different games and 4 levels in every game.

In the top right corner we have the score you gain from all the games and your daily challenges.

Beneath the score you have your “play chance lives” each time you enter a game you lose one life chance and it takes 30 minutes to gain one life back, when your at 0 life chance you’ll have to wait to play again until you’ll have at least one life.

A warning pop-up will show up when you’ll try to play again.



## Daily Challenge

On the bottom of the screen the first button from left(with the question mark sign) will open a pop-up which describe that you will get 100 points for the day you filling you daily challenge.

You'll need to fill for the more 6 meals you had at the current day and send it which is then stored at the log file in our Server Storage.

The daily challenge will open every day from 16:00 o'clock that you'll be able to fill at least 4 fields of the challenge. Afterwards you'll always have the option to make a correction at you submission but of course you'll get you 100 points only once.



## Leaders Board

The “cup” button will open the leaders board for you and will show the leading top 10 players in the game comparing their score it's iterating once on our realtime database server and getting the top scoring player.

After that on every score change we checking the option of the player to get into the leaders board and fill it in if he scored more that at least the 10th player on the board. By creating more competitive experience we motive the children to learn more in a short period of time and also make them to realize that their are not alone in this story.



## [Game 1]

The goal of the game is to collect icons on the road that represent gluten-free food. There are a collection of real world icons which the children might see on everyday products.

You'll need to recognize in short timer whether the icon is gluten or gluten-free and catch it before the time runs out and it's disappeared.

Every level will consist of more and more various icons that you'll need to recognize as fast as you can.



## ❖ Fast travelers

Implemented a way to get from one side of the screen to the other parallel side on the same road.

How It Works:

To every fast traveler have 2 objects, one is for "entry" and one is for "exit", when collision of the player collider with the "entry" collider identified by the player collider handler the player position is transform to the center position of the "exit" object. Works in both directions.



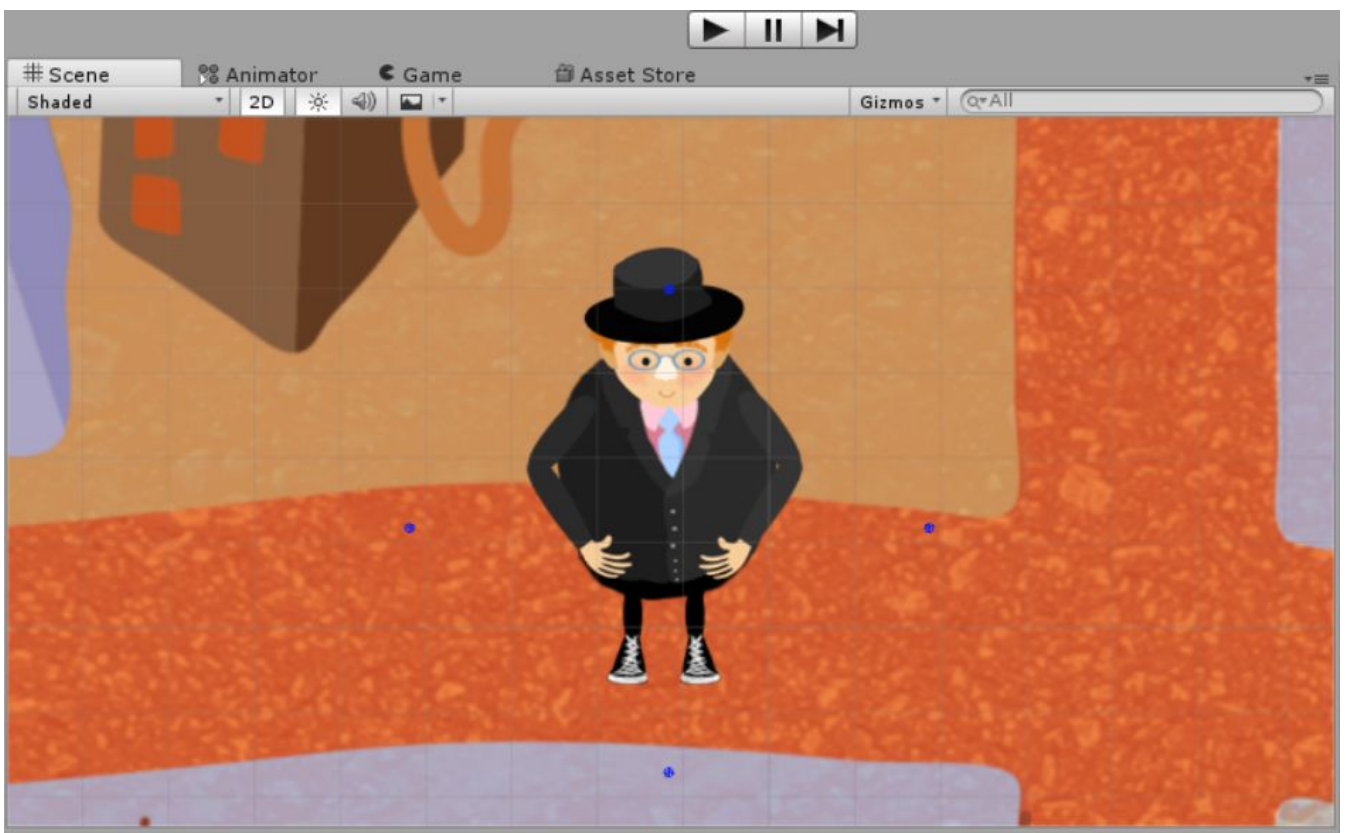
## ❖ Raycast

In order to limit the player to move to the road direction, between wall objects.

Raycast - Casts a ray, from point origin, in direction direction, of length maximum distance, against all colliders in the scene.

We set 4 raycasts, every raycast starts from the center of the player object and ends in one of the points that placed around the player.

In the player script we recognize all the wall object that the raycast hits and we limits the player movement accordingly to the realtime data we gets.





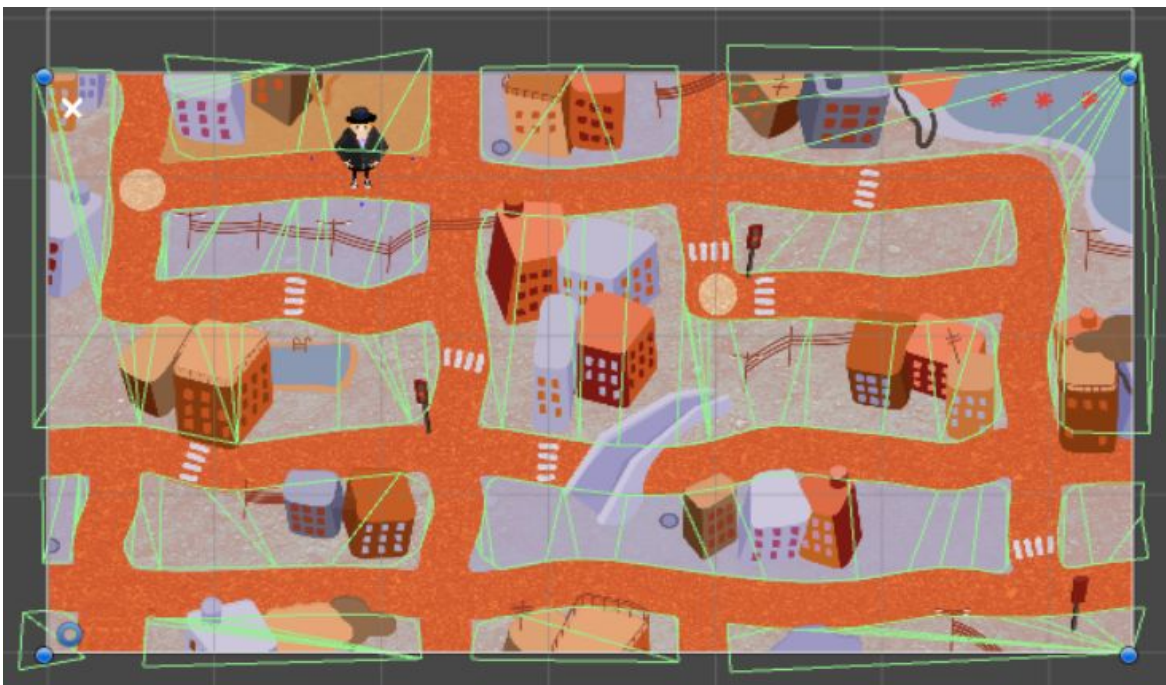
## ❖ Touch Controller

All the details to identify touch and the information about the places where touch was started and ended we get from class call "Input", in every call to the Update routine the input is tested to identify touch, and to calculate to which direction the player want to move.



## ❖ Level Design

We use box colliders to limit the movement area of the player by defining objects with polygon collider around areas that are not intended to the player movements which defined by the map that was created by our designers.

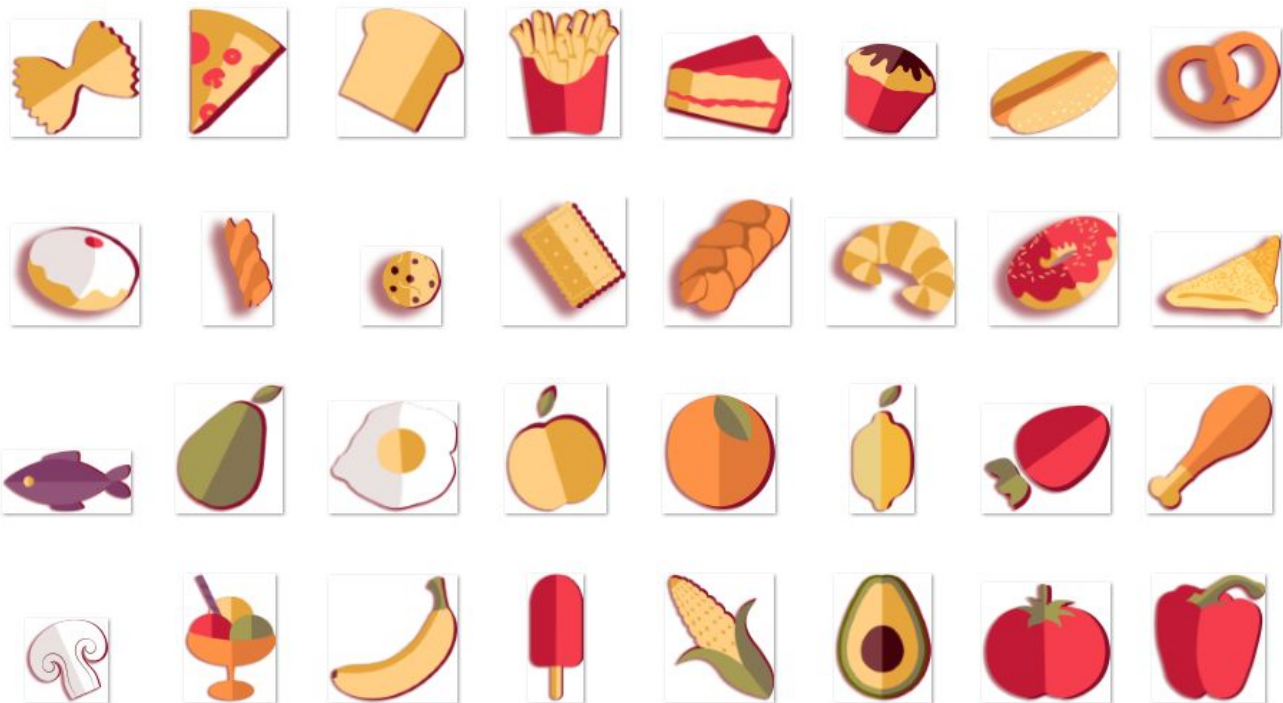


## [Game 2]

Game goal is to collect falling from the sky food that most likely is a gluten free product. For example - most likely an apple don't have gluten in it but a cake probably does. You'll need to catch the food with your basket.



Food example:



## ❖ Controller

In the bottom of the screen are located 2 buttons with left and right arrows on them.

when holding the button the player is moving in the pointing arrow direction.

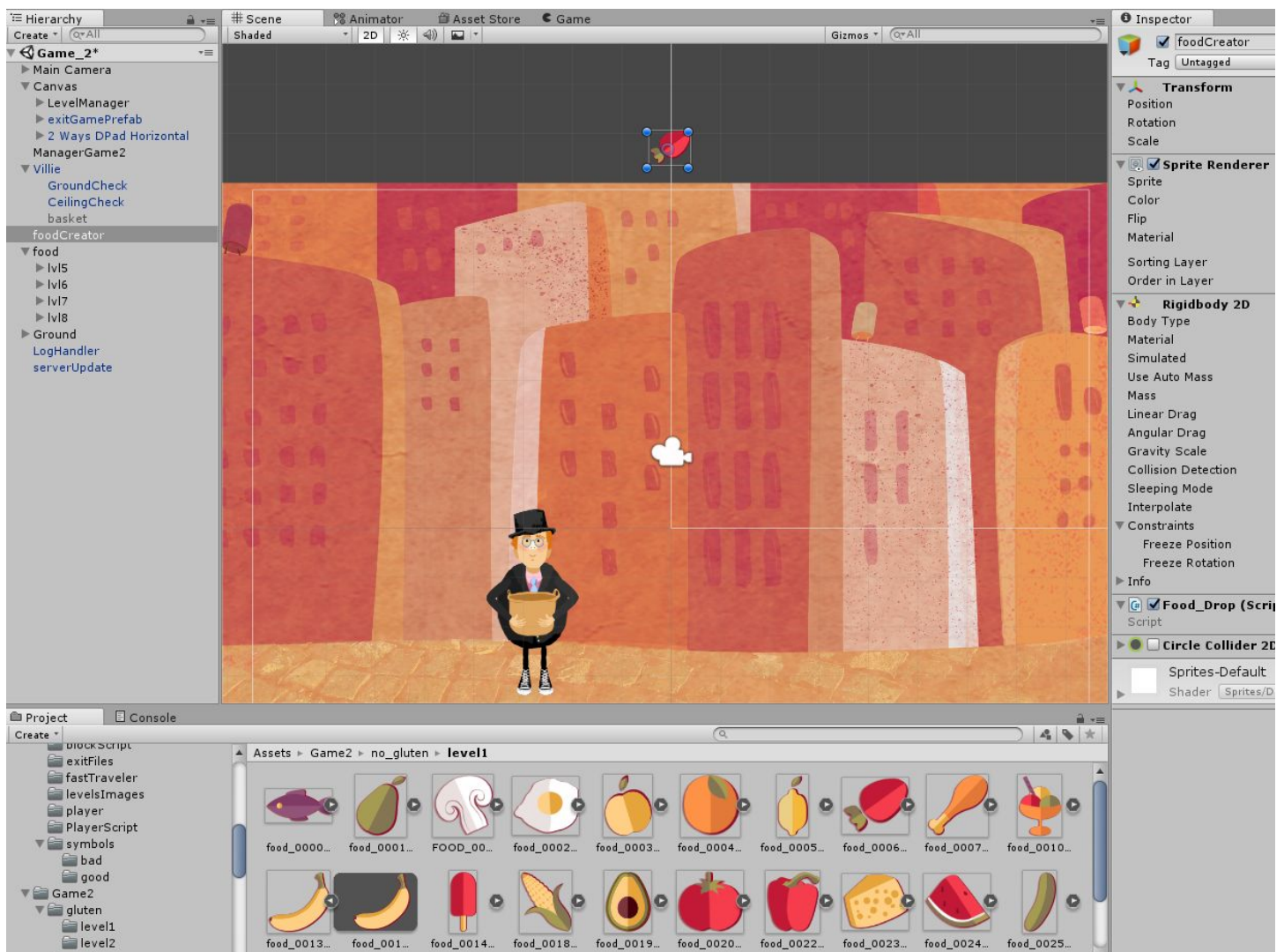
To have more realistic movement the player start moving slowly and accelerate over time.

The food use gravity to fall down and detect a collision with the basket or the world floor to find the result of your gameplay.

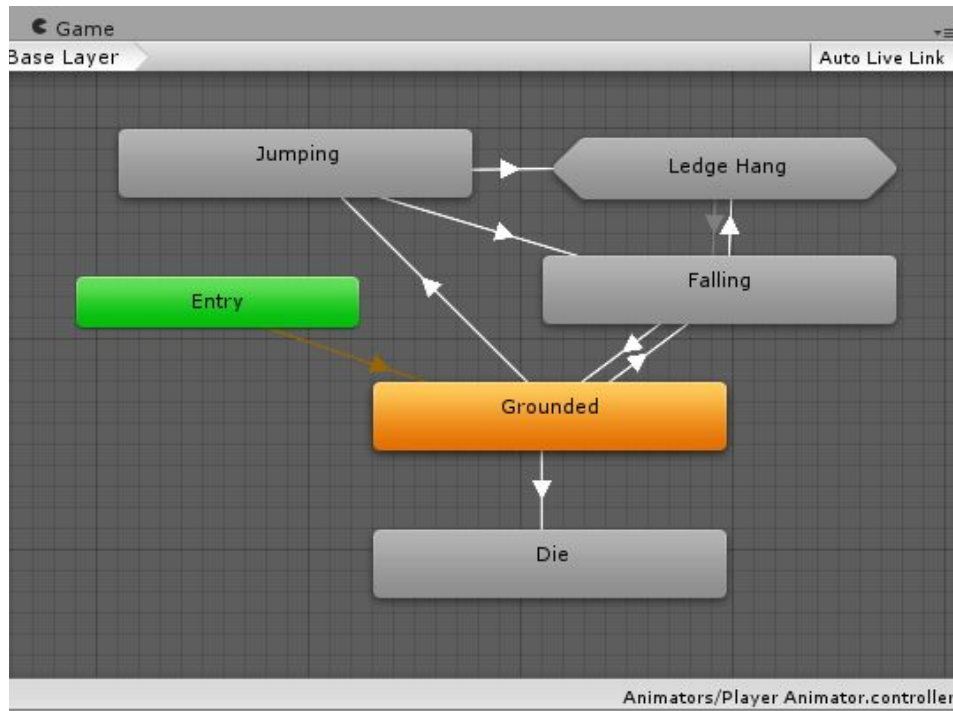


## ❖ Random food generator

By having lot's of different food icons, I created one scaled food object which have all the scriptures and all the properties and information needed for the food. Afterwards I randomize number that will tell me if to create a gluten free food or gluten food and the by creating a new instance of the object and randomize its position (that depends on screen width) a new food object is created and dropped down by the physics law.



❖ **Animation** - We created different animation to a several objects in our game. This is done by recording a movement of a model in the scene, afterwards you can control its states with the Animator Controller.



### ❖ **Lose/Win**

By collecting a gluten free food into you'll be able to grow your Villies one level up.

If you collect a food that contains gluten in it you will lose one life and reduce the Villies grow.

Also if a gluten free food will touch the ground it will be destroyed and you will lose one life and reduce the Villies grow.

We manage that by creating an appropriate tag to the food we generate at runtime and by checking the collision with the basket or the ground of the food and ti's tag we operate the scoring system script.

## [Game 3]

Game goal is to sort a real life supermarket product to a basket of gluten products or gluten free products.

Also you have at any time the option to open the product components to have a better understanding and if you look right you'll always get the right answer to any product.

The game design to be as much realistic as it could possibly be to prepare the kids to the real life shopping experience and to be able draw conclusion from the components they see.

משחק 3

עליך לפצל את המוצרים בקופה לשני סלים- עם גלוטן ובלי גלוטן.  
לחיצה כל המוצר תפתח את טבלת האלרגנים במידה והיא קיימת.  
לחיצה נוספת תסגור את הטבלה.  
התזוזה במשחק היא על ידי גרידה של המוצר לסל הנכון.  
מוצרים עליהם רשום "מכיל פחות מ-PPM20" - נחשבים ללא גלוטן  
מוצרים עליהם רשום "עלול להכיל גלוטן" - נחשבים גלוטן  
מוצרים עליהם לא רשום דבר - נחשבים גלוטן

משחק 3   משחק 2   משחק 1



## ❖ Drag and Drop

On icon hold a Drag Event is called.

Which create an instance of the image which follow you dragging position.

On icon release a Drop Event is called.

and check if dropped position is in the cell or not.

If it's outside of the cell boundary it will just destroy the draggable instance.

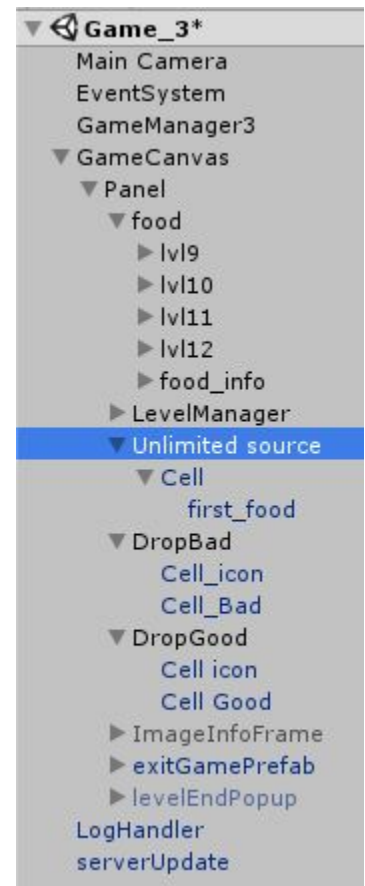
If it's in the cell, notify drag event end and check item and cell properties.

Check cell type - gluten or gluten free.

Check food dripped type gluten or gluten free.

In depend of that it will call life and villies calculations.

And on the end of it will generate new food object.





### ❖ **Random Product Generator**

By having lot's of different food icons, I created one scaled food object which have all the scriptures and all the properties and information needed for the food. Afterwards I randomize number that will tell me if to the next generation food will be gluten free food or gluten food and the by creating a new instance of the object and randomize its position (that depends on screen width) a new food object is created and dropped down by the physics law.



### ❖ **Lose/Win**

If you drag the gluten food in gluten basket and gluten free food into the gluten free basket the Villies will grow one level up.

Otherwise the Villies reduce they grow and lose one life.