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An affective gaming scenario using the Kinect Sensors

Christos Christou

SID: 3306150002

SCHOOL OF SCIENCE & TECHNOLOGY

A thesis submitted for the degree of

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SID: 3306150002

Supervisor:	Dr Eirini Kotsia
Supervising Committee Members:	Dr Gatzianas Marios, Dr Berberidis Christos

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Abstract

This dissertation was written as a part of the MSc in Mobile and Web Computing at the International Hellenic University with title an Affective gaming scenario using the Kinect Sensors. The dissertation has many different technologies combined in order to try to have an affective gaming scenario working. Three different software programs have been created in order to have a functional multiplayer online game. An iOS mobile application, a multiplayer game in which users can download from the iOS app store and play against other players around the world, a computer software that takes advantage of the Kinect sensor capabilities that will send data collected from the player state and emotions during gameplay and change dynamically the game flow and a server application that handles the communication between the other two components. Since the mobile clients have to communicate with each other and the mobile clients have to communicate with the Kinect application internet connection is needed and stable connection can be established with the software created on the server side.

Affective gaming is a cross disciplinary area drawing upon psychology, physiology, electronic engineering and computer science. This is how the affective gaming works, the user is playing a video game and a special device is collecting all the physiological signals and behavioral cues and turn them into data. An emotion analysis is taking place evaluating the data and then the game objectives and gameplay alters according to the player's evaluation. One special device that can be used to achieve all these is the Kinect sensor. It is a really powerful piece of hardware that can detect human physiological signals and behavioral cues with the correct software and offer emotion analysis. Having all these combined we will end up with the final application that is an iOS mobile game with a computer program that is bonded with the Kinect sensor and can make dynamic changes according to the player's emotions in the game flow.

All these different components will be analyzed. Analysis about how the affective gaming has taking its place in the game market, how the development of the Kinect sensor has contributed to general greater than games products, other ways of gathering and collection human expressions and data so that they can be transformed into bits and bytes so that software will visualize them to users and enhance the gaming experience.

Christou Christos

23/12/2016

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1. Introduction

Affective gaming also known as emotional gaming , establishes the newest bound for game design and game development having as an ultimate goal to be able to read the emotional state of a player who plays the game and use it to make changes to the game in such a way so as to provide to the player a more riveting experience, a better gameplay. However, existing affective gaming approaches use specialized sensors in order to extract behavioral cues, introducing in that way a variety of challenges. The main issue to be resolved is that of affecting the player's immersion in the game scenario by having an impact on the player's behavior, in terms of the actions and emotions the player displays. By using the term affective gaming we also refer to the new generation of games in which the players' behavior directly affects the games gameplay and objectives. To be more precise, the emotional state and actions of a player can be correctly recognized and properly used in order to change the gameplot and offer to the player an increased user experience feeling. In other words, the emotions and actions of a player are of extreme importance, as the behavioral cues extracted from them will define the way the game will progress.

Existing approaches in the field of affective gaming, briefly describing the sensors used to extract behavioral cues (mainly physiological ones) also presenting the commercial applications developed that employ those sensors. In addition. The proposed scenarios `use' Kinect to extract the behavioral cues under examination, that can be later used to evoke specific emotions to the players and alter the game's objective and plot, providing in that way a more realistic interaction between the player and the game.

Affective gaming is a cross disciplinary area drawing upon psychology, physiology, electronic engineering and computer science. This is how the affective gaming works , the user is playing a video game and a special device is collecting all the physiological signals and behavioral cues and turn them into data. An emotion analysis is taking place evaluating the data and then the game objectives and gameplay alters according to the player's evaluation.

Affective gaming in mobile games is something new and really interesting and mobile devices are trying to optimize their hardware in order to be able to succeed in this difficult task. Mobile games are part of our everyday life. Almost everyone is using the

mobile phone he carries in order to spend some minutes of the day and even hours by playing a game. Since the controller is missing most games on mobile phones and tablets are simply tap games. Fast passed games that enable the players to log in for a few minutes and play. Competitive and addictive since the game is an online multiplayer 1 vs 1 making the user to rank higher. The creation of a mobile game, which will offer Kinect connectivity is making the game unique compared to others. In order to be able to connect the Kinect with the mobile phone there must be an internet connection. To have access to the data that the Kinect will provide a software running on a computer will make the data travel from the computer to the server and then to the mobile phone and make game changes depending on the evaluation the detection algorithm did.

Currently there is no other game created on the iOS App store that enables the user to play a multiplayer arcade game using a Kinect Sensor. Why not make an affective game work on a phone? The Kinect Sensor can provide information about the state of someone playing so the game can be created with the help of this device. Although it is not that easy to have a setup of a Kinect sensor, a computer software and a mobile game and might seem not so easy to use it is a new way of making use of the Kinect sensor many people have (Xbox 360 was sold with the Kinect) but not use due to lack of great game titles. Moreover, making a game that will use a general software that collects data from the Kinect will show the way that every game can include the detection software and this combination to have the same effects during gameplay.

2. Kinect

2.1. What is Kinect

Microsoft is one of the biggest companies advancing in game technology. Two of the most advanced game consoles that are on the market created by Microsoft. Xbox One and Xbox 360 as well as PCs themselves create the ultimate gaming experience for those who like playing video games. The company decided to take gaming to the next level by starting developing Project Natal which was the first name of the device that wanted to change the experience and the way of playing games. During development Project Natal was renamed to Kinect and Microsoft started creating it in 2010 to advance the gaming experience of the Xbox 360's users. But what is actually Kinect. Kinect is a line of motion sensing input devices which lets the users have control over the game by using gestures and spoken commands. By using this device users do not have the need to use a remote controller. The first Kinect came out in the market for the users in November 2010 to be used with Xbox 360 console and later in early 2012 a Kinect version for Windows comes to the market. Microsoft competes in this new way of gaming with Sony which has developed Playstation move for Playstation 3 and Wii Remote Plus created by Nintendo. For software developers Microsoft released a software development kit for Windows 7 on 2011 so that they could be able to write Kinecting applications in visual basic .net, C++ or C#.

2.2. Kinect version 1

The first version of the Kinect created by Microsoft was a combination of software and hardware and it was created on 2010. A range chipset technology which was developed by PrimeSense is a system consisting of infrared protector and a camera with a

special microchip that can generate a grid from which the exact location of an object close to the camera can be detected in all three dimensions. Having this 3D scanning system called Light Coding the result is an imaged-based 3D reconstruction.

The Kinect sensor is equipped with an RGB camera, a depth sensor and a multi-array microphone all packed in a horizontal bar connected with each other with a motorized pivot. By running the proprietary software it can provide full body 3D motion capture, voice recognition capabilities which could support many different languages and facial recognition. The microphone array of the Kinect sensor enables to conduct acoustic source localization and ambient noise suppression. Another really interesting piece of hardware the depth sensor consists of an infrared laser projector which is combined with a monochrome CMOS sensor and enables the sensor to capture video data in 3D under any different light conditions. The sensing of range of depth sensor can be adjusted in addition to the Kinect software which is capable of automatically calibrating the sensor with the player's physical environment can detect the presence of obstacles and every physical object around.

About the software technology which is stated by Microsoft as the primary innovation of Kinect is that it enables gesture recognition, facial recognition and voice recognition. It is capable of tracking up to six different people simultaneously having to think only about the camera angle and space since the players have to be on the field of view of the camera and can support two active players to analyze their motion with a feature extraction of up to twenty points per player.

The Kinect sensor has a limit for distance and the range is between 1.2 - 3.5 meters. The space required to use the sensor is estimated on 6 meters ^2 although it is possible for the sensor to track through an extended range of 0.7 to 6 meters. The sensor has an angular field of view of 57 horizontally and 43 degrees vertically while the motorized pivot which hold the entire line of hardware can tilt the sensor up to 27 degrees either up or down depending on the positioning of the player. The hardware can support resolutions up to 1280x1024 at lower frame rate and color formats like UYVY but the default output video of the various sensors can have frame rate of 9 Hz up to 30 Hz depending on resolution. The default RGB video streaming uses 8bit VGA resolution with Bayer color filter. It is also possible for the Kinect to stream the view recorded from its IR camera

directly just before it is converted into a depth map at same frame rates as the camera. The microphone array consists of four microphone capsules and even channel can process 16bit audio at sampling rate of 16 kHz.

The Kinect sensor's tilt mechanism requires lots of power more than the USB can supply so the device uses a connector combing USB communication with additional power.

2.3. Kinect version 2

The second version of the Kinect was released on 2013. Major changes to both the way of working and the appearance of the sensor were made. This time the PrimeSense technology has been replaced by the time of light sensor which was developed by Microsoft. The new product hardware and software has improved a lot comparing it to its predecessor. Improvement on every capability software and hardware wise.

Now Kinect is packed with a 1080 color camera. The color camera can capture a 1080 video that can be displayed in the same resolution as the viewing screen in 30 Hz. It can now provide a more stable input on which to build high quality interactive applications by taking into consideration the improved video communications and video analytics applications. Body tracking has improved, the enhanced fidelity of the depth camera in addition to the improvements in the software made a lot of body tracking improvement and development. This sensor can now track six different people analyzing their movements compared to the two that the Kinect v1 could and can support up to twenty five joints per player compared to the Kinect v1 which could support twenty. The range of tracking the players is boarder proving more space for the players and the tracked positions are more anatomically correct and stable. The depth sensing has also improved. New improved 3D visualization with improved ability to see little objects that could not be detected in the previous version, showing object more clearly and better stability of body tracking. The sensor provides higher depth fidelity and a way more better noise floor. Finally the new active infrared capabilities which allows the sensor to be able to see in the dark. The sensor can produce a lightning independent view which lets the Kinect use simultaneously the new active infrared and the color camera to provide improved detection.

Kinect's camera contains hardware and software. It actually does two things. It can generate a three-dimensional moving image of the objects within its field of view and then recognize moving human beings among the objects it has detected. Looking at older software programs that used differences in color and texture to separate the objects from the background Kinect's v1 PrimeSense technology uses a different model. The camera is able to transmit invisible near infrared light and measure the time of flight it

reflects off the objects. This technique works like sonar, if you know the amount of time needed for the light to return then you know the distance between you and the object. Casting a big field whit many of pings moving back and forth at the highest speed, the speed of light you can now know how far away an object is. By using the infrared generator the problem of ambient light problem is partially solved. Since the sensor is not designed to register visible light it does not get quite as many false positives. PrimeSense and Kinect go a little bit further and start encoding information in the near infrared light. When the information is returned some of it is deformed and it can help to generate a finer image of those objects 3D texture and not just their depth. An on board processor is using algorithms to manage to process all the data to finally render the three dimensional image. It can recognize people and distinguish different body parts, joints and movement and individual human faces.

3. Affective Gaming

3.1. Affective Computing

Gaming industry is expanding rapidly and growing faster than ever. More research is being made to apply artificial intelligence to gaming application. Affective computing in gaming environment is one of the latest technologies used in building intelligent games. In affective gaming a person's emotions is one of the most important factors that plays the most important role in applying game intelligence and lead to better user experience. To map the decision-making abilities into to the hardware the player is using it necessary to have the appropriate technology and sensor to identify the emotions of a person and reposed to them. Most researches have shown that to determine the physiological parameters that can help to estimate an individual's emotional state. Skin Conductance, Heart Beat and Electroencephalogram are some of the most common used parameters. Use of the emotional state in computing lead to the field of Affective Computing. By determining human emotions there can be made huge evolution in many fields. Its importance has already been recognized in the filled of psychology, intelligent system design, entertainment industry and biomedical systems.

Affective computing is the development of new systems and devices that are able to recognize, interpret, simulate and process human affects. It is an interdisciplinary field spanning many different sciences like computer science, cognitive science and computer science. The origins of the field can be tracked back to the philosophical enquiries into emotion. Motivation for the research is the ability to simulate empathy. The machine has to interpret the emotional state of humans and adapt its behavior to them by providing an appropriate response for those emotions. There is a difference between sentiment analysis and affective analysis, which is the affective analysis detects the different emotion instead of identifying them.

3.2. Affective Gaming

3.2.1. Affective Gaming Meaning

Affective gaming is the new generation of games where the users behaviour affects the game gameplay and goals. The emotional state and actions of a user can be correctly recognized and properly used in order to alter the gameplay and offer to the user an enhanced and increased user experience feeling. Affective gaming is a cross disciplinary area drawing upon psychology, physiology, electronic engineering and computer science. This is how the affective gaming works, when someone is playing a video game and there is a special device which is collecting all the physiological signals and behavioral cues and turn them into data.

An emotion analysis is taking place evaluating the data and then the game objectives and gameplay alters according to the player's evaluation. The actions and the emotions of a user are the most important as the behavioral cues extracted from them will define the game progress and flow of the story. In order to make the user experience better and please the user more, affective gaming focuses on highlighting the importance of including emotional content in systems. By characterizing emotions we have two dimensions of emotion, the valence emotions and the arousal. The valence ranges from highly positive to highly negative and the dimension of arousal ranges from calming to exciting. Emotion plays a central role in learning, in the training of new cognitive and affective skills, and in the acquisition of new motor skills. Emotion is also critical for the acquisition of new behavioral skills, as well as for the elimination of undesirable behaviors like addictions.

3.2.2. Affective Gaming Development Area

Games are being developed for health-related education, training and cognitive and motor rehabilitation. The emerging area of *affective gaming* is therefore directly relevant to the development of educational, training, and therapeutic games. Affective gam-

ing focuses on the integration of emotion into game design and development, and includes the following areas: recognition of player emotions, adaptations of the gameplay to the players' affective states, and modeling and expression of emotions by non-playing characters

Games are being increasingly used for educational and training purposes, for a variety of specific topics and domains (language, biology, mathematics, motor skills, cognitive skills, healthcare and medical training, military training). Games have a unique ability to engage students, and to provide customized learning and training protocols. This makes serious educational and training games a powerful tool for teaching and training.

In addition, the emerging discipline of affective gaming contributes to the design of more engaging and effective educational, training and therapeutic games, by explicitly integrating emotion into the gameplay. The importance of emotion modeling is high and this has a major contribution for affective computing. Emotion modeling is relevant both for modeling emotions in game characters, to enhance their believability and effectiveness, and for the development of affective user models, to enable real-time gameplay adaptation to the player's changing affective state.

3.2.3. Affective gaming Abilities

Affective gaming has:

- The ability to generate game content dynamically with respect to the affective state of the player. Knowledge of the player's affective state allows the game to deliver content at the most appropriate moment. For example, playing a horor based game, the optimum effect of a loud noise will only occur if produced when the player is incredibly tense and in fear after being detected.

- The ability to communicate the affective state of the game player to third parties. With the advent of on-line gaming it is more frequently the case that the player's opponent is not physically present. However, it is often the emotional involvement of other players that shapes our enjoyment of a game. Affective Gaming technology can address this issue by having the on-screen persona reflect the player's emotional state.

- The adoption of new game mechanics based on the affective state of the player.

- *Affect-sensitive games*, are capable of recognizing and adapting to the player's emotional state. It introduces the notion of *affect-centered games*, which are games where emotions play a central role, and whose explicit purpose is to train affective and social skills, or to aid in psychotherapy. There are also several concepts that facilitate the design and development of educational, training, and therapeutic games, including the notions of *affective player profile*, *affective gameplay profile,* and the *optimal affective envelope* of the player. a tool that would facilitate the development of affect-centered games, by providing the necessary embedded representational and knowledge primitives, and algorithms, to support more systematic affect-focused game design.

3.3. Emotions

What are emotions? Emotions are defined as short states that reflect a particular affective assessment of the state or self or the world and are associated with behavioral tendencies and cognitive biases. We can distinguish them into universal and complex. Universal like anger, disgust, fear, happiness, sadness and surprise and complex like guilt, pride and shame. Emotions are often defined in terms of their roles so being distinguished in those involved in interpersonal, social behavior and this involved in intrapsychic, regulation, adaptive behavior and motivation. Four interacting modalities, the most visible which are the behavioral/expressive modality like facial expressions, speech, gesture, postures and behavioral choices, the somatic/physiological modality , the neurophysiological substrate making behavior and cognition possible , the cognitive/interpretive modality which is associated with the evaluation based definition of emotions and the experimental/subjective modality which is the conscious and inherently idiosyncratic experience of emotion within the individual.

Recognition of Human emotions have application in many fields. One of the fields is the entertainment industry where affective computing is used to enhance user experience, to set exactly the amount of challenge games and to reinvent the user interaction in the retail industry. Not only in entertainment but also in customer experience determination. The emotion detection can be applied in customer experience determination by estimating the customer's emotional responses to a product. So it helps redesigning the brand perception providing a greater satisfaction for the customers. Furthermore in psychology affective computing is being used to monitor mental health and improve emotional wellbeing. Affective computing in this domain is used to assist in leading the needs and social skills of children which are diagnosed with Autism. This technology helps to monitor depression, sleep and stress patterns. Application in this field which is

also helping is in the case of Epilepsy, where it helps recognize the anomalies in the nervous system activity that precede seizures. Also in intelligent system design affective computing is used to help systems understand emotions and respond accordingly, like gesture based guitar, engaging concerts to determine reactions to musical expressions and system to practice social interactions in face to face scenarios are some examples. Another domain is in the biomedical system where affective computing is being used to remotely monitor vital signs of humans. Blood pressure, heart rate and breathing rate, improving the delivery of healthcare helping the amount of interactions between doctor and patient and help reduce the need for trained stuff during diagnostic tests.

Human emotions can be related to a lot biological parameters. In order to determine the structures of the brain research has made in neuroscience to relate them to human emotions. The electrical charge stored on neurons in these structures were studied by using electroencephalogram. Not only this but also the importance o skin conductance seem to be the most responsive human emotions. Other parametersf include facial expressions, posture, blood oxygen and Elecrooculogram. An electroencephalogram can be used to read signals from different lobes like the frontal lobe, the parietal lobe, the occipital lobe, the temporal love, the limbic lobe and the insular lobe and then classify those signals into emotions.

The galvanic skin response (GSR) where the skin conductance is an objective index of emotional responses. Since skin conductance response has proven to respond to stimuli in a reasonable amount of time we included it as a parameter.

Pulse sensor can detect heard beat variability and associate it with the change in emotional state of a person. Whenever someone is doing a strenuous task or when excited heart beat rises. The pulse sensor can be used in fitness monitor to make sure that the heart rate does not cross unwanted levels.

Emotion has a leading role in the training of new cognitive and affective skills, in learning and in the acquisition of new behaviors and motor skills and in the limitation of undesirable behaviors. Emotion modelling has to do with both the modelling of emotions in game characters to enhance their believability and effectiveness and for the development of affection user models to enable real time gameplay adaptation to the player's changing affective state.

Emotion plays a central role in learning, in the training of new cognitive and affective skills, and in the acquisition of new behaviors and motor skills, as well as in the eliminations of undesirable behaviors (e.g., addictions). The emerging discipline of affective gaming contributes to the design of more engaging and effective educational and training games, by explicitly integrating emotion into the gameplay. It focuses on the contributions from affective computing, and emphasizes the important role of emotion modeling. Emotion modeling is relevant both for modeling emotions in game characters, to enhance their believability and effectiveness, and for the development of affective user models, to enable real-time gameplay adaptation to the player's changing affective state. The notion of affect-centered games: games whose central objective is to train affective or social skillsAlso there are several concepts facilitating the design and evaluation of affect-centered games: affective player profile, affective gameplay profile and ideal affective player envelope.Modeling emotion in game characters.

3.3.1. Emotion Classification

Cross cultural research made by Paul Ekman proposed the idea that facial expressions of emotion are not culturally determined but universal. So he suggested that they are biological in origin and can be safely and correctly categorized. According to this research there are six basic emotions which are Anger, Disgust, Fear, Happiness, Sadness and surprise. Latest studies by Ekman expanded the list of basic emotions including both positive and negative emotions. Not every emotion is encoded in facial muscles. The new emotions are Amusement, contempt, contentment, embarrassment, excitement, guilt, pride in achievement, relief, satisfaction, sensory pleasure and shame.

3.3.2. Emotional Speech

We can take advantage of the fact that many changes in the autonomic nervous system indirectly is able to alter speech and use this information to produce systems capable of recognizing affect based on extracted features of speech. If someone is in state of joy or anger speech becomes faster and louder, or even in case of fear, having higher and wider pitch range. Other emotions like boredom or sadness, tiredness, lead to slower and lower pitched speech. Emotional speech processing recognizes the user's emotional state by analyzing speech patterns. Vocal parameters and features such as pitch variables and speech rate are analyzed through pattern recognition. Speech recognition is a marvelous method of identifying affective state, having a high success rate. Taking into consideration that it is even for humans sometimes difficult to understand the emotions of someone who is talking the speech recognition works really well, identifying emotions but still insufficient compared to other forms of emotion recognition like physiological states or facial processing. Another difficulty in achieve greater success ratio is that there are many different speech characteristics that are independent of semantics or culture , which also makes the technique really promising to use.

3.3.3. Emotion with the Kinect and other machines

Detecting and recognizing emotional information need sensors which can mature data about the user's behavior or physical state which interpreting the input. All the data gathered is analogous to the cues humans use to perceive emotion s in others. Kinect sensor offers a video camera which can capture facial expressions, body posture and gestures and also a microphone which can capture speech. Other sensors detect emotional cues by directly measuring physiological data just like the galvanic resistance and the skin temperature. Being able to recognize emotions information requires the extraction of meaningful patterns from the data that are gathered. This can be achieved by using machine learning techniques that process different modalities such as speech recognition, facial expression detection, natural language processing and then produced visual data in a valence - arousal space.

Emotion in machines, another area within affective computing is the design and creation of computational devices purposes to exhibit either innate emotional capabilities or that are capable of convincingly simulation emotions. Considering the current technological capabilities, a more practical approach can be made which is the simulation of emotions in conversational agents in order to enrich and facilitate interactivity between human era machine. We can associated human emotions with surges in hormones and other neuropeptide, emotions in machine can be associated with abstract states associated with progress or even lack of progress in to autonomies learning systems. By taking a look at this view affective emotional states correspond to perturbations in the learning curve of an arbitrary learning system.

Emotional component of HCI in video games. Game players frequently turn to the console in their search for an emotional experience. Affective games try to assess the affective state of video game players. The ability to generate game content dynamically with respect to the affective state of the player. Knowledge of the player's affective statement allows the game to deliver content at the most appropriate moment. The ability to communicate the affective state of the game player to third parties. The emotional involvement of other players that shapes the enjoyment of the game. Affective gaming technology can handle the issue by having the on-screen persona reflect the players

emotional state. the adoption of new game mechanics based on the affective state of the players**.**

In neuroscience and cognitive science someone can find two models leading and being able to describe how the humans perceive and classify emotion. The first model is the continuous and the second is the categorical model. The first one defines each facial expression of emotion as a feature vector in a face space. With this model, it is possible to explain how the expressions of emotion can be seen at different intensities. The second on, the categorical model consists of C classifiers each tuned to a specific emotion category. With this model, someone can find out why why the images in a morning sequence between a happy and a surprise face are perceived as whether happy or surprise, without being able to perceive something in between.

3.4. How to detect emotions and expressions

3.4.1. Facial affect detection

The detection and processing of facial expression can be achieved by many different methods such as optical flow, neural network processing or active appearance model. Modalities can be combined or merged to provide a more accurate evaluation of the player's emotional state. Combining facial expressions and speech, hand gestures and text can lead to multimodal recognition.

3.4.2. Facial expression databases

If someone wants to create an emotion database is a really difficult task and time-consuming. Database creation of emotions though is an essential part in the creation of a system that will recognize human emotions. Most of the available emotion databases include posed facial expressions. What is the difference between posed and spontaneous emotion? In posed expression databases the participants display different basic emotional expressions, on the other hand in spontaneous databases these expressions are natural. Spontaneous emotion elicitation needs a lot of effort though in the selection or proper stimuli which may lead to rich display of intended emotions. In spontaneous databases the process involves tagging of emotions by trained individuals manually, which makes the databases more reliable and accurate. But expressing an emotion , the way of perception and the intensity that it is shown are subjective the annotation by experts is a must in order to validate all the data the individuals where able to provide. There are three types of databases, the database of peak expression images only, the database of video clips with emotional annotation and the database of image sequences portraying an emotion from neutral to its peak. There are a lot of facial expression databases that have been created and are available to the public for expression recognition purposes.

3.4.3. Facial Action Coding System

The FACS is a system that is defining expressions in terms of muscle action to categorize the physical expression of emotions. The main goal of this system is action units. Action units are a construction or a relaxation of one or more muscles. This might seem simple but it is fairly enough to form the base of a complex and devoid interpretation of emotional identification system. Scientists are able to map the different identified facial cues to the corresponding action unit code.

3.4.4. Facial Electromyography

Facial electromyography is a technique that we can use to measure the electrical activity of every facial muscle and by amplifying the tiny electrical impulses that are generated by muscle fibers when they hit each other have results. Every face can express emotion but there are wo main facial muscle groups that we can check to detect the emotion. The corrugator supercilii muscle which is the frowning muscle and draws the brow down into a frown and thus is an accurate test for negative or unpleasant emotional response and the second is the zygomaticus major muscle which is responsible for the pulling of the mouth corners back, when a face is smiling. This muscle is used to detect positive emotional response.

3.4.5. Galvanic skin response

Known as GSR is a measure of skin conductivity and is dependent on how moist the skin is. Every time someone sweats, he produces moisture and glands are controlled by the body's nervous system there is a correlation between GSR and the arousal state of

the body. If the subject is aroused, skin conductivity and GSR reading are becoming higher as the arousal gets higher too. Two silver chloride electrodes placed on the user skin are applying voltage between them. The conductance is measured by a sensor. To reduce irritation and maximize comfort those two electrodes can be placed on the users feet and thus the player can have the hands free to use any device.

Using galvanic skin response GSR measurements to determine state of arousal. GSR measurements are suitable for states like relaxation and stillness they are inappropriate tools for meaning affect when playing fast paced video games. GSR equipment works by testing the conductivity of the skin. The higher the players state of arousal is the more the player sweat and the greater the skin conduction. The electrical resistance of the skin will change if the player tightens a muscle or perspire heavily. That is not a problem when the game designed to induce states of relaxation but totally inappropriate for fast paced arcade style games requiring quick fingered dexterity like the game mobile game which has been developed the technology has to be suitable to the gaming environment. It is preferable if the current video game technology is used to measure affect rather than introducing new gaming experience. Specialist peripheral hardware is rarely adopted in large numbers wind in turn limited the financial investment to produce games the utilize such equipment.

4. About the Game

Having combined all these technologies and different IDEs and programming languages the result is an iOS multiplayer online game, taking advantage of the Kinect sensor capabilities. It can support up to two users per game, whether they do have or not a Kinect Sensor they can still play the game. Two different softwares are the components making the game complete. The first one the game which the user will have installed on the iPhone or iPad and another one, that the user will have installed on a computer running Windows 10, having connected the Kinect sensor with a Kinect windows adapter.

The story of the game is all about Cloud Computing. Some young developers have decided to attack and destroy the Cloud and the players have to protect their data centres in order to avoid destruction. Every player has a main character in the game, the cloud protecting their base and both players have to stop the intruders from attacking and destroying their base.

The game is not Kinect dependent, which means that it can be played by all users even if they do not own a Kinect. But an internet connection is needed in order to find an opponent and compete to each other since the game is multiplayer arcade - fighting.

The player can start the game and find an opponent. If a user has the Kinect connected there is an indication in the game screen that this user is “Kinected”, which actually means that the user has a Kinect and uses it during the game. The software that runs on the computer will collect data from the reactions of the player during the game and post all of them to the server. By using WebSockets the real-time communication between the client personal computer and the server computer will be really fast and all the data will be transferred to the server end Point, where they will be sent to both mobile clients. The user who is using the Kinect experiences game changes depending on some facial expressions and reactions during the gameplay. Another feature is that the

user with the Kinect will be able to send emoticons to the other user in real time with face gestures, like closing the eyes or mouth. The Kinect software will collect all the expressions and turn them into data and after that it will send them to the server.

The Cloud is real time multiplayer tap mobile game which can be played and offer better user experience when the player is using a Kinect Sensor. The goal of the game is to manage to survive before the enemies take down the datacenter base which is located in the middle of each stage.

The two players have one side, whether the right or the left and they have to protect their side not to get knocked down. The enemies during the game will spawn through each side of the screen. For the player on the left enemies will spawn from the left side of the screen and try to destroy the left side of the datacenter in the center of the stage. When the player destroys an enemy, the enemy will spawn on the other side to attack the other player. Enemy capabilities, health and attacks varies. The two players by killing the enemies on their side collect points which help them upgrade their main weapon of killing or give them extra health. By killing some enemies some power ups might appear on screen. The player who is faster and taps on the power takes it. Both players can also attack from the other side too because they might want to kill helpers that spawn on each side and try to fix each players base. The two players have to destroy the enemies coming from their side before they destroy their main base which is positioned in the center of the stages. Winner of the battle is the player who succeeds in saving his base before it gets destroyed.

When someone uses the Kinect sensor the Kinect can detect the player's emotions and depending on the player's satisfaction on the game the cloud that the player has as the main character in his game changes dynamically colors. Stroke colors creating the cloud and main color filling the cloud in addition to the face that is inside the cloud indicate if the user is feeling happy or sad. Another feature the Kinect Sensor provides is that when the player is moving all the time or standing still many animation clouds will appear next to the main controlling cloud and provide more animations to the tapping of the player.

Last but not least the player can send to the opponent player emoticon, like real time communication messages but without the need of typing or pressing additional buttons.

The Kinect sensor can be used there as a controller to provide an easier and faster functionality. All emoticons appear in the middle of each stage, animating from the bottom base to the top of the screen. Having the Kinect will not provide the player extra power but it is just to enhance the player experience. Both players will be able to see the game changes since the server will post everything to both mobile clients.

The game also provides the user a ranking screen where every player can see the global ranking and if they have subscribed as users who use the Kinect sensor when they are playing.

4.1. Game requirements

Having all of these different technologies combined so that the game can be working properly there are many different requirements for each platform- component that helps this game to be complete and fully functional.

4.1.1. Main requirements

- Create a software that will use Kinect capabilities to provide data for the user's reactions, expressions and face detection.

- Connect this software using Websockets to a server in order to transmit the data collected from the player.

- Create a server application that will receive data from the Kinect application and

- Add functionality to the server application to send the Kinect data to the mobile clients

- Create the mobile game

- Connect the mobile game to the server using WebSockets so that the mobile client will be able to send and receive data from the other mobile client

- Create a receiving functionality in the mobile client for the Kinect data that will be send form the server.

- use the data posted from the server to clients and show the results.

4.1.2. iOS Game requirements

- Have two players, left and right part of the screen.

- Establish and maintain connection between the two players taking part in the game.

- Create enemy objects with health attack and time to reach their goal, destroy players base.

- Create enemies during gameplay for both players playing the game using innovative algorithm based on the kinect feedback and the players gameplay progress.

- Create dynamically power ups during the game and handle them when tapped by the players.

- Use Kinect provided data during gameplay so that the results for posting emojis or emotion data collected from the player using the Kinect sensor are being displayed as the have to.

4.1.3. Kinect Application Requirements

- Receive input from the player's facial expressions and emotions in order to make them in to computer data.

- Make a connection with the server and send the data to the corresponding players of the game.

4.1.4. Server application requirements

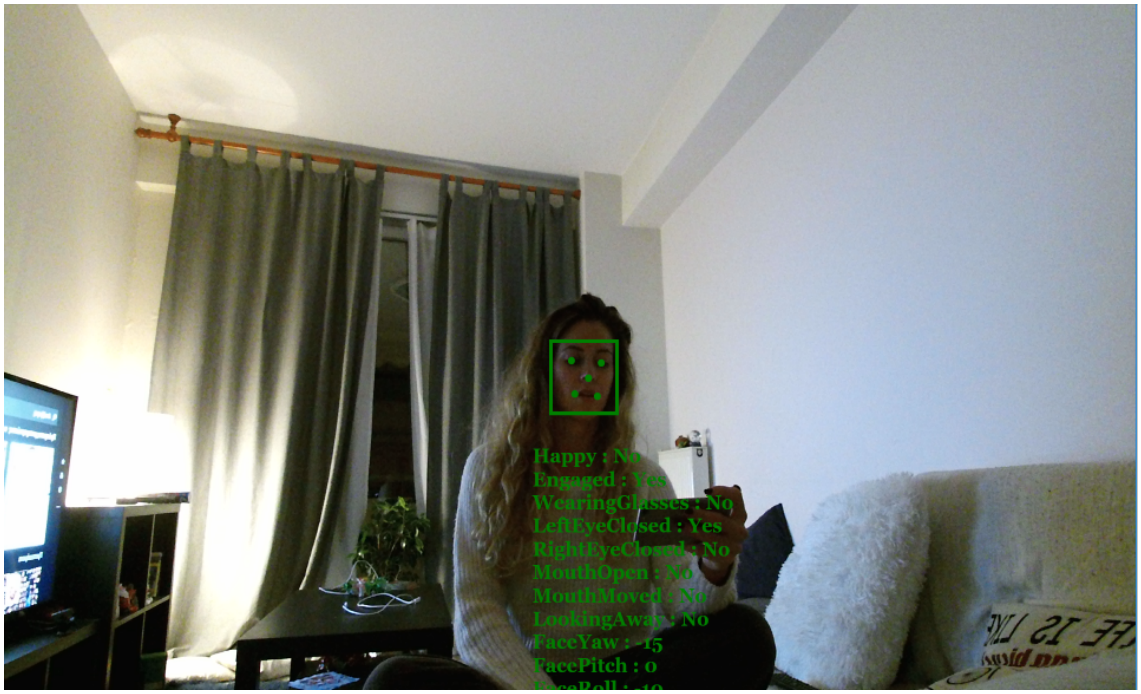
- Create a game for two players.

- Connect the mobile client(game) with the pc client (Kinect application).

- Receive and send data from and to the clients.

4.2. Kinect images

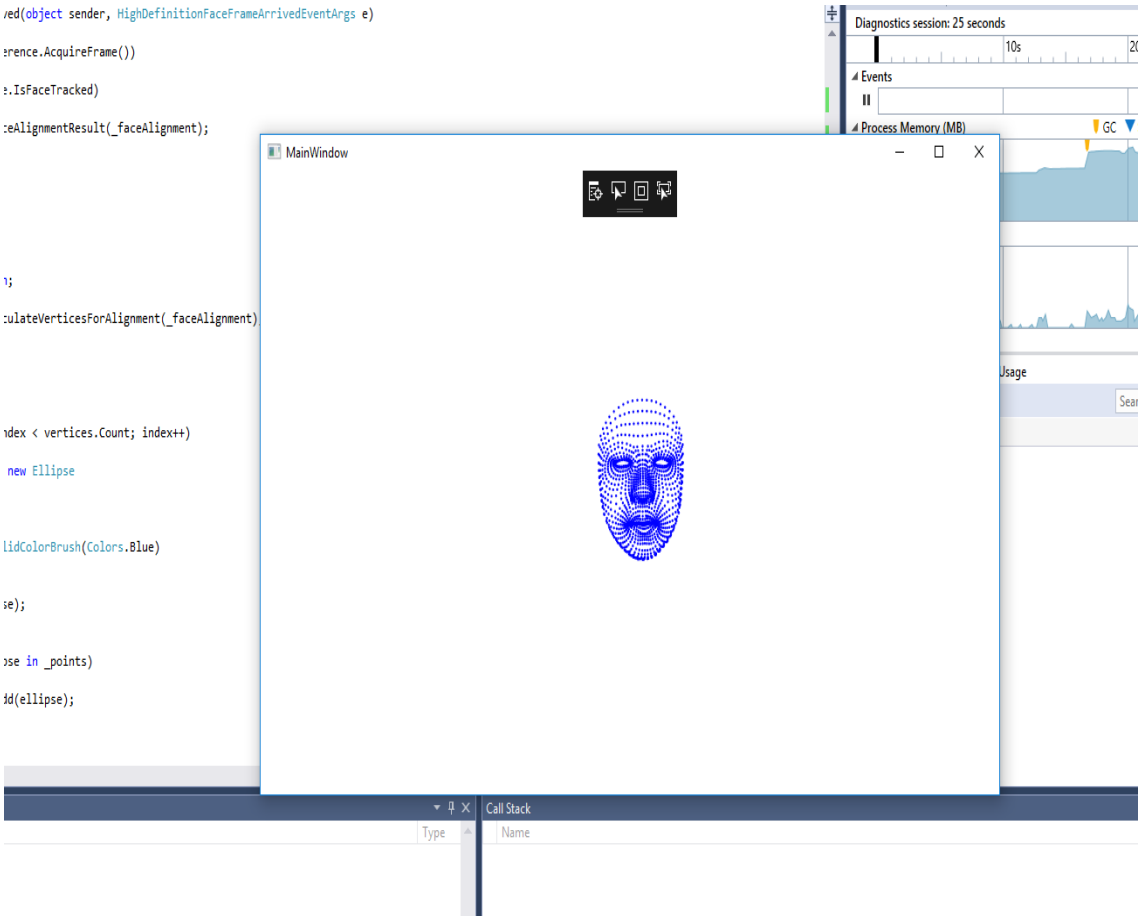
- Face detection providing visual data real time for the person shown on the screen. The program can detect if the person is happy, see if the person is engaged to the Kinect camera, if the person is wearing glasses, if the left or the right eye is closed, if the mouth is open or closed and if the mouth is moving.



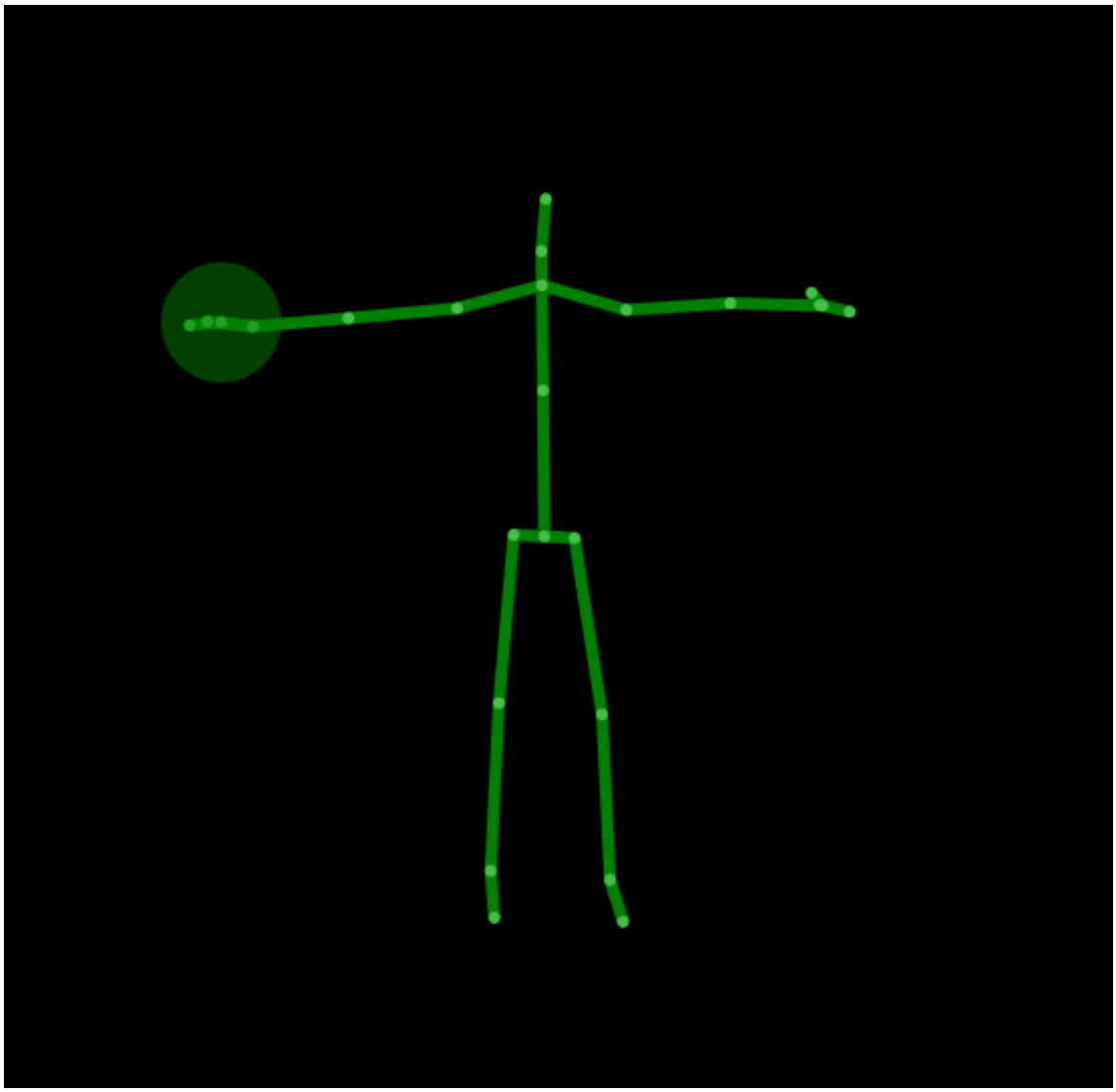
- This is an image showing in 3D space the face of the user standing in front of the Kinect Sensors. The movement and the expression of the face can be caught and transformed into data to be used in the mobile phone afterwards.

- The active infrared which can detect depth and objects inside complete darkness.

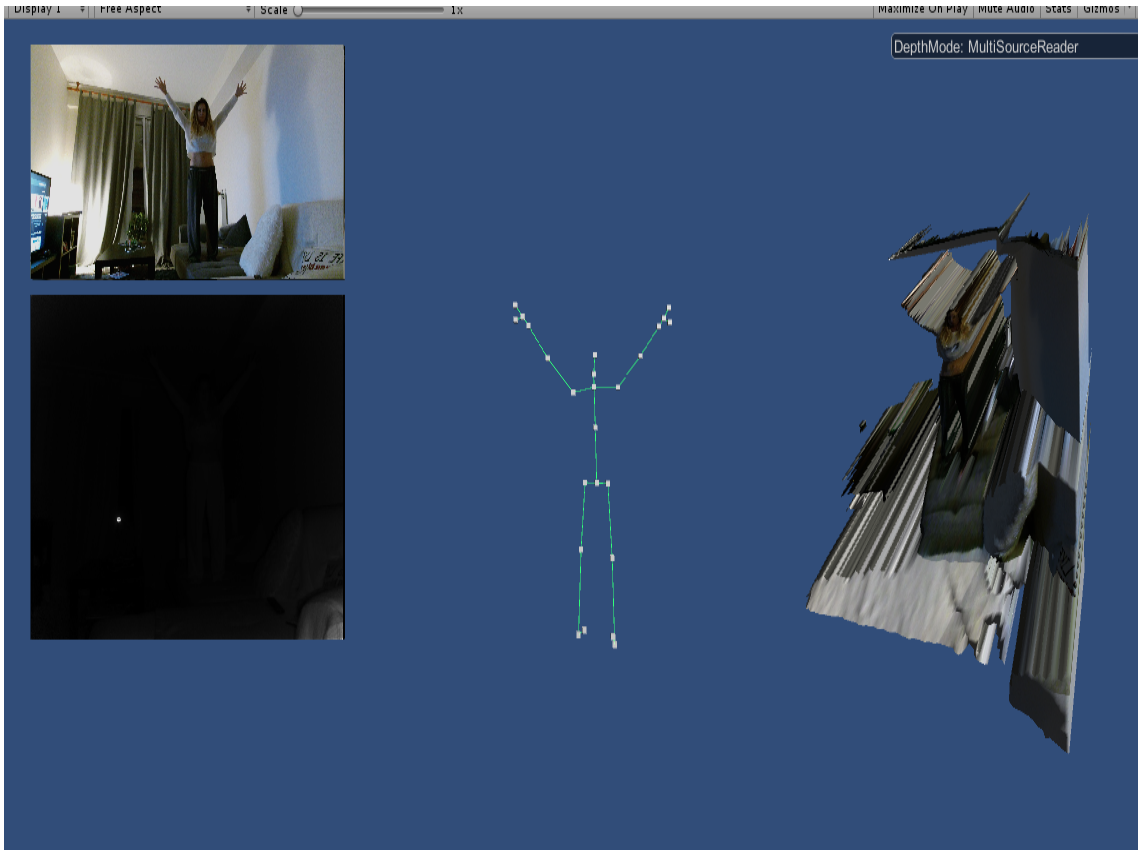
- This image is a 3D representation of the face of the person standing in front of the Kinect camera. Many different points detect the human face and move along with the movement of the face of the user.



- Skeleton representation of the user standing in front of the Kinect Sensors. Joint are marked with lighter green. The user can move and the camera can detect with very little latency, accurately the movement of the person standing in front of the Kinect sensor.



- Skeleton representation of the user standing in front of the Kinect Sensors with depth view on the right and infrared view on the bottom. This is an image taken from a unity project created to test the Kinect sensor functionality. Joint are marked with lighter green. The user can move and the camera can detect with very little latency, accurately the movement of the person standing in front of the Kinect sensor.



4.3. iOS game Images

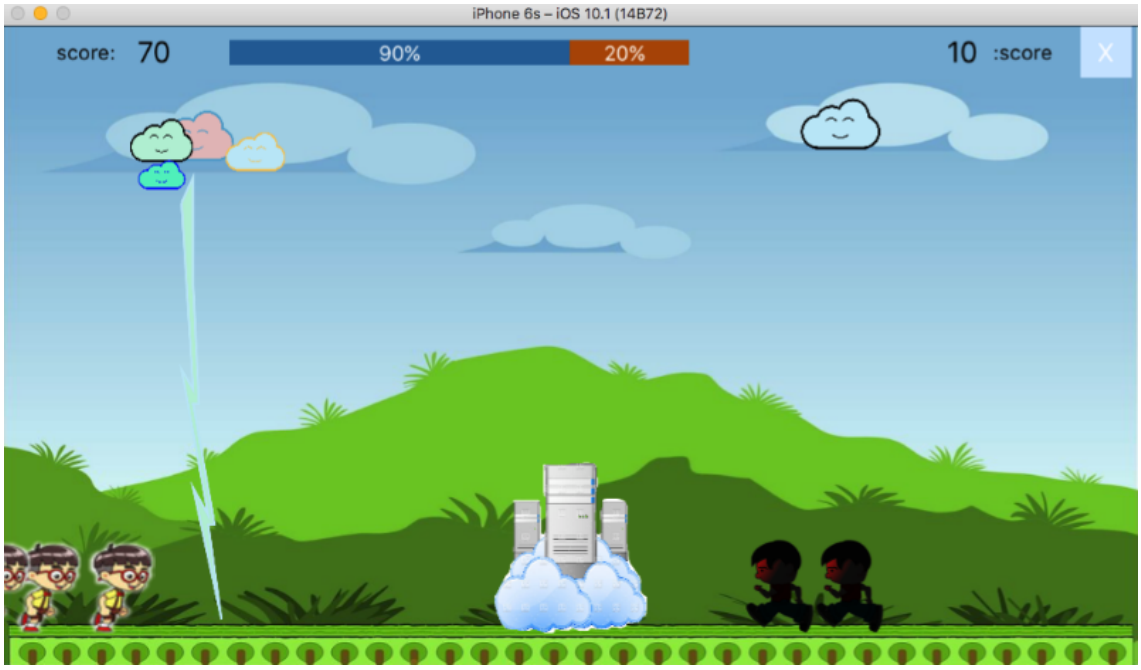
- This is the starting screen of the game. The player can choose if he wants to start the game by tapping on the top button or choose to see the ranking on button at the bottom.

  By pressing the start game button the mobile sends a request to the server to find an opponent. Once the opponent is found the game starts.

- The player who is using the Kinect sensor can see the clouds on the left and on the right changing colors depending on his face detection data provide by the Kinect sensors. The clouds change stroke and fill color and the face inside the cloud indicating the state of the user, happy or not.

- When playing, the user can tap anywhere on the screen and the attack animation is playing. If the hit is successful animations over the hit enemies show, the players score increases and a new enemy will spawn on the opponent player side.

- When using a Kinect sensors the player can send emoticons to the game main screen and both players can see them while playing. An indication in the bottom center informs the two players about who is using a Kinect Sensor along with the game.



- User is “Kinected” is the term the game uses to reveal to the players that someone is using it during the game.

The player on the left is “Kinected”, which means that he uses the Kinect sensors. The Kinect collects data from the player and sends data about the emotional state of the player. The mobile application code converts those data and shows those results on both players device as emojis.

4.4. Code samples for Kinect facial detection

Below there are snippets of code written in order to have the Kinect data collection from the player using the Kinect sensors.

```
private void StartCapture()
{
    if (this.currentModelCollectionOperation != null)
    {
        this.StopFaceCapture();
    }

    this.faceModelBuilder = this.highDefinitionFaceFrameSource.OpenModelBuilder(FaceModelBuilderAttributes.None);
    this.faceModelBuilder.CollectionStatusChanged += this.FaceModelBuilder_CollectionStatusChanged;
    this.faceModelBuilder.CaptureStatusChanged += this.FaceModelBuilder_CaptureStatusChanged;

    this.currentModelCollectionOperation = this.faceModelBuilder.CollectFaceDataAsync();
    this.currentModelCollectionOperation.Completed = new AsyncOperationCompletedHandler<FaceModelData>((IAsyncOperation<FaceModelData> asyncOp, AsyncStatus status) =>
    {
        if (status == AsyncStatus.Completed)
        {
            using (var modelData = asyncOp.GetResults())
            {
                this.currentFaceModel = modelData.ProduceFaceModel();
            }

            this.StopFaceCapture();
            currentCaptureStatusString = "Capture Complete";
            currentCollectionStatusString = "";
        }
        else if (status == AsyncStatus.Error)
        {
            this.StopFaceCapture();
            currentCaptureStatusString = "Error collecting face data!";
            currentCollectionStatusString = "";
        }
        else
        {
            this.StopFaceCapture();
            currentCaptureStatusString = "Collecting face data incomplete!";
            currentCollectionStatusString = "";
        }
    });
}
```

```
private void InitializeHDFace()
{
    this.sensor = KinectSensor.GetDefault();

    this.bodySource = this.sensor.BodyFrameSource;
    this.bodies = new Body[this.bodySource.BodyCount];

    this.bodyReader = this.bodySource.OpenReader();
    this.bodyReader.FrameArrived += this.BodyReader_FrameArrived;

    this.highDefinitionFaceFrameSource = new HighDefinitionFaceFrameSource(this.sensor);
    this.highDefinitionFaceFrameReader = this.highDefinitionFaceFrameSource.OpenReader();
    this.highDefinitionFaceFrameReader.FrameArrived += this.HDFaceReader_FrameArrived;

    this.currentFaceModel = new FaceModel();
    this.currentFaceAlignment = new FaceAlignment();
    this.cachedFaceIndices = FaceModel.TriangleIndices;

    this.UpdateFaceMesh();

    this.sensor.Open();
}
```

```
private void HDFaceReader_FrameArrived(object sender, HighDefinitionFaceFrameArrivedEventArgs e)
{
    var frameReference = e.FrameReference;

    using (var frame = frameReference.AcquireFrame())
    {
        if (frame == null || !frame.IsFaceTracked)
        {
            return;
        }

        frame.GetAndRefreshFaceAlignmentResult(this.currentFaceAlignment);

        this.UpdateFaceMesh();
    }
    this.StatusText = this.MakeStatusText();
}

private void FaceModelBuilder_CollectionStatusChanged(object sender, CollectionStatusChangedEventArgs e)
{
    var modelBuilder = sender as FaceModelBuilder;

    FaceModelBuilderCollectionStatus newStatus = modelBuilder.CollectionStatus;

    this.currentCollectionStatusString = BuildCollectionStatusText(newStatus);
}

private void FaceModelBuilder_CaptureStatusChanged(object sender, CaptureStatusChangedEventArgs e)
{
    var modelBuilder = sender as FaceModelBuilder;

    FaceModelBuilderCaptureStatus newStatus = modelBuilder.CaptureStatus;

    this.currentCaptureStatusString = GetCaptureStatusText(newStatus);
}

private void StartCaptureButton_Click(object sender, RoutedEventArgs e)
{
    this.StartCapture();
}
```

```
if (bFaceTracked) {
    IFaceFrameResult* pFaceFrameResult = nullptr;
    RectI faceBox = {0};
    PointF facePoints[FacePointType::FacePointType_Count];
    Vector4 faceRotation;
    DetectionResult faceProperties[FaceProperty::FaceProperty_Count];
    D2D1_POINT_2F faceTextLayout;
    hr = pFaceFrame->get_FaceFrameResult(&pFaceFrameResult);
    if (SUCCEEDED(hr) && pFaceFrameResult != nullptr) {
        hr = pFaceFrameResult->get_FaceBoundingBoxInColorSpace(&faceBox);

        if (SUCCEEDED(hr))  {
            hr = pFaceFrameResult->GetFacePointsInColorSpace(FacePointType::FacePointType_Count, facePoints);
        }

        if (SUCCEEDED(hr)) {
            hr = pFaceFrameResult->get_FaceRotationQuaternion(&faceRotation);
        }

        if (SUCCEEDED(hr)) {
            hr = pFaceFrameResult->GetFaceProperties(FaceProperty::FaceProperty_Count, faceProperties);
        }

        if (SUCCEEDED(hr)) {
            hr = GetFaceTextPositionInColorSpace(ppBodies[iFace], &faceTextLayout);
        }

        if (SUCCEEDED(hr)) {
            m_pDrawDataStreams->DrawFaceFrameResults(iFace, &faceBox, facePoints, &faceRotation, faceProperties, &faceTextLayout);
        }
    }

    SafeRelease(pFaceFrameResult);
}
```

5. Technologies Used

5.1. Technologies

- Bitbucket for the version control of all the software products that have been created in order to have complete control of the progress of work that has been made and have the ability to access source code throught every stage of development.

- Providing the web resources needed to succeed the online part of the game. Since the game is an online multiplayer game and the communication between the mobile clients and the computer application client has to be made through internet connection okeanos is providing both a virtual machine and a free operating system to have the internet service running.

- Running on the a virtual machine hosted by Okeanos web resources. Easier raid configurations and file sharing and storing system with a greater security and data protection ubuntu in addition to the access in the termial command line make ubuntu a better choise.

- GlassFish is an Application Server which can also be used as a Web Server Handling HTTP requests.Server running support WebSockets

- To write and execute the code and the Kinect Sensor SDK version 2

- C# is the programming language used to develop the Kinect software compatible with Windows 10. C# is a multi-paradigm programming language encompassing strong typing, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines.

- Swift 3 is used to develop the game for the iOS client. Swift 3.0, the first major release of Swift since it was open-sourced, is now officially released! Swift 3 is a huge release containing major improvements and refinements to the core language and Standard Library, major additions to the Linux port of Swift, and the first official release of the swift package manager.

5.2. Main Technology Setup

The game is an iOS multiplayer game so in order to have connection to the internet network resources are in need. Hosting resources are provided by Okeanos, https://okeanos.grnet.gr. Okeanos is the Greek word for ocean and oceans stand for abundance. Since oceans have transformed our world, they capture, store and deliver energy and life around the planet and is the unfailing well of earth's resources and thus the name of the explanation of the infrastructure. Okeanos is GRNET's cloud service, IaaS, Infrastructure as a Service where a personal computer can be built and be always connected to the Internet without hardware failures, connectivity hiccups and software troubles. Virtual Machine and Virtual Network creation where someone can manage them, destroy or connect to them and do all actions through a web browser. Okeanos is free and available for the Greek Research and Academic Community. it gives the opportunity to use software on virtual machine and test different kinds of software easily without hav-

ing to worry about specific hardware or physical space. So a Virtual machine of 40Gb is provided for academic purposes using Linux operating system, Ubuntu 10.4. On top of this a GlassFish server, Java EE 7 Application Server installed on virtual machine will support the backend services of the game needed. GlassFish is an open source application server created by Sun Microsystems and sponsored by Oracle in order to run on the Java EE platform. It is a free software that let developers create applications with high scalability and portability and succeed in integrating legacy technologies. For additional use of services many different components can be installed. GlassFish uses a derivative of Apache Tomocat as the servlet container for serving Web content and another component named Grizzly which offers greater scalability and speed and uses Java New I/O. On top of this for the communication purposes between the client mobile devices and the server the usage of WebSockets make the in-game communication more efficient and client server http requests provide login and opening usage of the application on the mobile devices.

5.3. Connection

WebSockets is an advanced technology that makes it possible to open an interactive communication session between the user's browser and a server. With this API, someone can send messages to a server and receive event driven responses without having to poll the server for a reply. WebSockets are the best solution for real time multiplayer games. There is an initial handshake where the HTTP connection is upgraded but when the connection is established WebSockets offer the lowest latency connection mechanism for bi directional communication for a client and a server. The general idea of using a socket is that it is a port through which the data can go in and out of. Trying to make an image of it , it is a real trading port for data and the socket itself is a similar to the dock where the exchanges are taking place from the application point of view. Sockets are low level and abstract and many protocols can use them. Most common on the internet are HTTP, SMTP, FTP, POP3 and lower level transfer protocols like TCP and UDP which determine how to interpret the data moving to and from the socket and the

communication of the machines that is taking place. WebSockets are actually an extension of the socket structure.

Best solutions for solving the problem between the connection of the clients playing the game on the internet is using client server communication. This can be achieved by using HTTP protocol and WebSockets. WebSockets are most appropriate for chunks of binary data and custom low level protocols and server push like chatting and game application that need real time streaming connection. WebSockets are essentially raw TCP-Sockets and do not have an overhead that the HTTP carries and transfers through every request. Comparing the performance of HTTP and WebSockets protocol HTTP is slightly faster because it is able to utilise cache. WebSockets on the other hand save bandwidth because there is no need to send a request to the server in order to obtain new information.

HTTP is the most common protocol was invented for the world wide web has limitations. Whenever a new request is made a post is opening and data start transferring and then the port closes. The opening and closing creates overhead and for some applications like games which need fast responses or real time interactions and stream of data this does not work. Another limitation of the HTTP protocol is that in order to get data a request must be made. The server cannot push data to the client when it wants to. The client have to poll the server for all the new information by making repeatedly requests within a small time interval to check if there is something new to obtain. On the other hand WebSocket protocol is very flexible for transferring data form the server endpoint to the other which is the client. Comparing WebSocket to HTTP we see that WebSocket remains open for communication so that data can be pushed to the client in realtime on demand. The overhead of opening and closing connections is a performance advantage that the WebSocket has over the HTTP. The use of polling compared to the pushing is huge burden on servers. By using HTTP having repeated requests to the servers asking for data that might not be updated is like request for nothing since nothing has changed so this leads to wasting resources and putting heavy load on the server without any need. The performance of WebSockets is way better. The efficiency is on both sides , server and client. No unnecessary work for the server replying to clients with no new data so fewer servers resources are in need. Furthermore the clients do not

need to waste networking resources and battery life for polling and making requests. A greater scalability and reliability provided by the WebSockets which can service heavy traffic easier. In terms of development though making WebSocket work on both sides, server and client is more difficult and more time consuming. In order to achieve WebSocket connection working on the iOS devices Starscream is used. Starscream is a conforming WebSocket client library in Swift for iOS. Some of the features of Starscream are that is supports TLS/WSS, conforms to all of the base Autobahn test suite, non-blocking where everything happens in the background and simple concise codebase.

5.4. Swift 3 & Xcode 8

The game is written in Swift 3. This is the programming language that the game is developed through the Xcode to create the game for iPhones and iPads. Swift is a new programming language for iOS, mac Os, watch OS and tv OS applications that builds on the best of C and Objective C without having the constraints of C compatibility. It is designed to scale from the simple applications to the most complex ones. This new language offers patterns and adds features that make programming more flexible , safer and more efficient. Swift is backed by Cocoa and Cocoa Touch frameworks in order to have the best results on coding applications. Apple decided before many years to create a new programming language and advanced the framework Infrastructure and existing compiler. Memory management is simplified with Automatic Reference Counting. Swift adopts the readability and the power of Objective C dynamic object model. It unifies the procedural and object oriented portions of the language and introduces a lot more new features which support blocks, collection literals and modules making easier the adoption of other frameworks and new language technologies without disruption. Apples engineering culture is passed to Swift which has an optimized performance in compiling and optimization on development without compromising on either.

Swift 3.0 has huge differences from its predecessors. Swift 3 arrived on September 13 of 2016 and brought major changes. Xcode 8 is required in order to be used. The biggest update in Swift 3 involves the standard library adopting consistent naming conventions across libraries used. Better readability and accessibility to new developed and the core team operated on the principal that Good API design always considers the call site.

The API has improved. It has gotten smarter about how Objective C libraries are transformed into native Swift. Swift 3 brought improvements on Xcode 8 which is the development IDE. Improved string hashing which results in 3x speedup in dictionaries of strings and by moving objects from the heap to the stack a huge improvement in speedup has been achieved. Furthermore code size optimization has reduced the compiled size of Swift code.

5.5. C# & Visual Studio

In order to have the Kinect sensor work and see the magic of body tracking, face recognition and voice recognition the appropriate software must be developed. Unity and Visual Studio as the most common IDES enable that kind of development, the creation of a new software program which can take advantage of the Kinect capabilities and turn them into data for further usage. Utilizing the infrared and color streams the Kinect sensor can provide accurately thousands of facial points. The Kinect for Windows Software Development Kit (SDK) 2.0 enables developers to create applications that support gesture recognition and voice recognition using Kinect sensor technology on computers running Windows 10. Currently Microsoft has created and provided us with the Face Basics API and the HD Face API. Considering both APIs the Face Basics is offering limited capabilities in the 2D space. As for the second one , the HD Face the Kinect SDK v2 provides us a really impressive API and it is the most advanced face tracking library open source for developers. It can detect human face and over a thousand different point real time in the 3D space just within a few milliseconds and it gives us access to raw facial data. The Face Basics can detect basic points of a face like eyes, nose and mouth and facial expression and inside a rectangle box the head of a person in 2D space. The expressions which can be detected are opened or closed eyes, engagement on the camera, looking away and happiness. Another feature which is provided is the detection of accessories such as glasses.

C# is a multi-paradigm programming language including strong typing, imperative, declarative, functional, generic and object component oriented programming disci-

plines. It is created by Microsoft and it is designed for the Common Language Infrastructure. It is an object-oriented programming language and the most recent version is 6.0. C# is meant to be simple, modern, general purpose and object oriented language. Therefore the implementations should provide support for software engineering principles such as a strong type checking, array bounds checking, detection of attempts to use uninitialized variables and automatic garbage collection. Software robustness, durability and programmer productivity are important. Also the language is intended for use in developing software components suitable for deployment in distributed environments. It is suitable for developing applications for both small dedicated functions to very large operating systems. At start the language was not designed to compete on performance and size with C the C# application that are created are economical regarding the memory and processing power requirements.

5.6. Hardware System Requirements

In order for the Kinect to work a Windows 10 computer having more than 4 gb of RAM and a usb 3 port that enables the sensor to be detected by the computer and offer to it the power and bandwidth needed to work. Neither a virtual box 5.0 and above version nor a computer without USB 3 are able to run a program that takes advantage of the Kinect capabilities. Virtual Box running Windows 10 cannot use the usb3 full bandwidth and thus the Kinect sensor cannot be functional.

In order to play the mobile game the user has play the game with an iphone having iOS 9 and above.

5.7. Source Control

All of these different technologies have to be secured during the development process. The usage of a version control to keep all the code which is implemented is

crucial. Bitbucket is the tool responsible for the version control. Version control systems are a category of software tools that help a software developer manage changes to source code that happen over time. Version control software keeps track of every modification to the code in a like a database file system. Developers can turn back if a mistake occurs and compare earlier versions of the code to help fix the mistake or revert it to a previous state. With the version control software checkpoints are created in the work that is done and allows the developer to go back to those points when ever he wants. This essential means revisiting your work back in time. Once the developer is back in such a checkpoint he can deviate from the original path that he chooses. This is exactly what version control provides. When using the free plan of BitBucket up to 5 different users are allowed and the project's source code can be private so no one else can access it.

6. Games

6.1. Why people play video games

People love playing games because a video game is a combination of a good story, a film, a book. a graphic novel, a photograph, a verbal telling. A motion picture is just many photographs shown a t high frequency giving the illusion of motion. A video game is the digital version of that. A video game is interactive. Why do people like video games? Because video games offer stress relief, since life is full of stressful events and by playing someone can escape that stress by playing a video game. When someone is playing a video game, he or she is drained into a virtual world forgetting the real one. Video games offer the feeling of running away, some people get addicted to games because they are too afraid to face the real problems. Running away from the mess in real life is easy when someone is playing video games. Regaining control is also another effect of players. Due to the fact that many people think they lost control over their lives seek other areas where they can take back some of their lost control. A controlling person might have become that way just because he feels the he lacks control over his life. Redemption, for people who fail to give up their dreams they might escape to a game fantasy world where they can get a chance to fulfill them. Dopamine rush, because the human's brain doesn't care about what kind of thing it gets addicted as long as it provides enough dopamine. Dopamine is the chemical responsible for the excitement we feel when we are competing to get something. Lots of people get addicted to the amounts of dopamine video games allow them to experience. Peoples brain also contains nerve cells that are collated mirror neurons. Those cells allow us to put ourselves in someone's place and experience the same emotions. When we play a video game we experience the same emotions as the main Hero inside the game experiences. The problem solving and self-esteem boost. Many games contain puzzles that give people a self-esteem boost when they succeed in solving them. Even if some games do not have puzzles make players feel good about themselves as long as they master the game. Defeating other players or even the software make people feel superior to others and

elevate their self-esteem. At last the most important reason is aesthetic pleasures that video games offer and for this reason there are specific aesthetic motives of play and we can characterize these motives in terms of the emotional experiences associated with them. Not all players have the same needs and have different motivations for an engaging in play. There are lots of motives but someone can categorize them into three different general categories. The social motive, the thrill seeking motive and the curiosity motive are general aesthetics motives for play.

6.1.1. What is need for a video game to make it affective

In order to have an affective videogame, both player and videogame have to be responsive to the affective signals of the other. For players, this has always been so; as emotional beings we respond both to the general game-playing experience such as enjoying play, and to the more provocative affective elements a videogame offers like emotionally-packed stories. However in conventional videogames the system has no means of assessing the player's emotion beyond the conscious control instructions like moving left or go right. In order to have truly affective videogames the system needs to be able to sense aspects of the player's emotions more directly.

A typical gaming scenario involves a player interacting with a game by a specialized input device, such as a joypad, a mouse or a keyboard. Recent technological advances have enabled the introduction of more elaborated approaches in which the player is able to interact with the game using his/her body pose, facial expressions, actions, even his physiological signals by using heart beat rate, encephalogram, even skin conductivity. The future lies in 'affective gaming', that is games that will be 'intelligent' enough not only to extract the player's commands by his speech and gestures but also by his behavioral cues, and his/her emotional states and adjust their game plot accordingly, in order to ensure more realistic and satisfactory gameplay experience.

There are many different dimensions for the involvement of digital games like Kinesthetic involvement, spatial involvement, shared involvement, narrative involvement, ludic involvement and affective involvement. The lack of differentiating between

different forms of engagement with the game is something really challenging when it comes to player experience.

6.2. Kinect gaming

When the Kinect for Xbox 360 was introduced it looked so promising and like future technology. Being able to track body movement and equipped with infrared camera sensors and microphones letting someone control games and media by just using the body or voice. Latest Microsoft console Xbox one has just only seven games released since if became available to gamers. The initial goal was to broaden the Xbox console's appeal. Use part of your body to play a game without the need of a controller. The new technology sold big and really good at start as it was the most promising enhancement for leveraging the gaming experience and was a must in order for the Xbox to be functional but then the problems of using this new technology started to come up. Not enough great games. Existing games like Halo had an incredible precision when played with a controller so in order to give the players the same controlling ease and success was too difficult and time consuming with the Kinect Sensor. Even though some of the best developers thought it would be really nice to develop for the Kinect they found out that the cost of making games state of the art was difficult and time consuming. Games like Street Fight require precise button inputs. Accuracy problems like not working properly was really frustrating for the users. Using voice commands and the software failing in reproducing them to the correct meaning created many problems and did a bad effect on user experience. Most of gamers prefer precise movement and the fail of the faulty input from the camera or the microphone do not make the accurate experience that people wanted.

Another problem is that using the Kinect sensor requires a lot of space. And most of the users can not and are not willing to move furniture in order to be detected by the sensor for body tracking and movement. Having to play in a distance of six to ten feet between the player and the sensor is really frustrating in a small apartment especially when you want to play local multiplayer. In addition to all these when Microsoft decided to change the Kinect sensor and create a version 2 which would go along with the new Xbox one was not a good announcement making the gamers unwilling to try the new Kinect. Performance wise the Kinect version 2 might be way better than the Kinect version 1 but the gamers with the lack of titles and the gimmick integrations with the

interface. On 2014 Microsoft decided to sell separately the Xbox One console and the Kinect Sensor which was the final retreat by the company since the creation of this futuristic technology. But this new technology lead to other new possibilities except from gaming.

The Kinect Sensor has been around for years. Many games have been created , different categories of them for Microsoft devices like Xbox One, Xbox 360 and Windows PC. Xbox one users are those taking advantage of the full Kinect experience since they control the game without the need of a controller but only by using their own body and voice commands. Most of the games make use of the body tracking system the Kinect sensor offers. The users can user their body to avoid obstacles, to jump over fences, to throw items, to shoot with a gun, exercise and do sports or even dance.

6.2.1. Applications using the Kinect

Kinectimals is one of the best games ever created. It is a virtual animal raising game. Mostly developed for kids but everyone can enjoy playing the game. A tiger is the main character of the game and the player can use voice commands like jump, roll over or even play dead the tiger will act as it is ordered. Scratching the head will make the pet purr with joy. Just dance is the game the most people associate the Kinect with. It is a fun dance game and it is enjoyable both in solo play and way better in multiplayer mode being able to be played simultaneously by eight local players. The gameplay consists of mirroring the digital music video on screen and matching the moves that appear in a timely fashion. Xbox Fitness is designed to provide Xbox One players the way to stay fit. Videos play on screen in addition to the Kinect tracking body movement recording the intensity and even how much weight or stress is being applied to all muscle groups. It is also able to record stats for each different section of a workout and can compare it to the user's friends making the players compete each other like a challenge game. Using the technology of this game provides great source of motivation especially when it works. Fruit Ninja Kinect 2 is another great game that uses lots of the Kinect features. Hand gestures swipe exactly as the player is moving and the accuracy is one of the best.

Apart from various games the Kinect technology can lead to many different technologic innovations. Microsoft has Leveraged Xbox Kinect's Technology into superb and brilliant new business areas. Areas like healthcare, education, retail and business to business products. Innovative products and applications have been developed like demonstrations of Boing 737 airplanes where viewers can interact and expand video demos screen and see more details. Another really interesting product is the Big Data visualization that can transform data int visuals that show maps of the geography where the reserver are located. As for healthcare applications physical therapy rehabilitation where the application remotely tracks skeletal movement in patients doing physical therapy exercises at home. It transmits their performance to the therapist who can provide real time feedback to the patient. Another product created combines game theory and physical therapy exercises to make rehabilitation for patients more fun. It relays rehab progress to clinicians monitoring their progress. The effect of using this application it that the patients will exercise more religiously. Another great health product has been created is monitoring individuals with the disease for the onset of seizures so they can be controlled or averted in a timely fashion and people that help and take care of patients no longer have to be up during the night worrying about detecting signs of oncoming seizures. Fashion software has also been developed where a customers can find the best fitting jeans by scanning the body and making measurements and 3D depth. After that the customers can by moving their arms swap between outfits snap a selfie and share them to social networks. With Kinect technology an educational learning company has made learning more fun and physically interactive for kids by teaching spelling, shapes and spatial relationships through motion, visual and sound rewards.

Games are more and more used for training and educational purposes due to the fact that they have a unique ability to engage students and provide customized learning and training protocols. More and more games are being developed for health-related education and training, psychotherapy and for cognitive and motor rehabilitation.

7. Questionnaire

20 people played the game and were asked afterwards different questions in order to provide feedback about the game, the game experience they had and what they think about the whole idea of the project.

The results of the questionnaire can be shown below:

Question 1:

Did you enjoy playing the game?

Answers:

Yes: 90 %, No: 10%

Question 2:

Do you think the Kinect sensor collected the correct data and provided the results that it should?

Answers:

Yes: 50%, No: 50%

Question 3:

Do you think more games should be like that, trying to analyze your emotions?

Answers:

Yes: 80 %, No: 20%

Question 4:

Was it easy and comfortable to play having the Kinect Sensor in front of you and play the game on the mobile phone?

Answers:

Yes: 10%, No: 90%

Question 5:

Do you think that the Kinect was able to detect your emotions?

Answers:

Yes: 50%, No: 50%

Question 6:

Have you ever heard before the term Affective gaming?

Answers:

Yes: 5%, No: 95%

Question 7:

Would you prefer an Augmented reality game than an affective game like this?

Answers:

Yes: 70%, No:30%

Question 8:

Would you prefer a Virtual reality game over and affective game like this?

Answers:

Yes: 95%, No:5%

Question 9:

Have you ever used the Kinect sensor before?

Answers:

Yes: 5%, No: 95%

Question: 10

Can technology reach the goal of understanding completely human emotions?

Answers:

Yes: 85%, No: 15%

After having all the answers from the questionnaire having all of them gathered there are some results considering the ease of use the Kinect sensor and the data collected.

- Most of the testers complained about their position in front of the Kinect Sensor. Having to face towards the camera was very uncomfortable, not only playing the game through a mobile phone but also games for Xbox.
- Most of the testers like a lot the idea of emotion driven games but believed that this is not happening through the Kinect sensor. They thought that they did the expressions in order to see the changes happen on the game instead of having some emotions created by the game and then game reacted according to them. They used it more like a controller than a device that reads their emotion and acts according to them.
- Most of the testers thought that this technology and game theory would be better in the future, especially when combined with virtual reality or augmented reality the results will create the ultimate gaming experience.

8. Conclusions

The game market is a huge and vast market. It is on of most profiting markets and many game consoles and titles are being developed every year. Surpassing the movies industry and having a great influence and big impact on the everyday lives especially those of younger ages people. Game consoles like Playstation or Xbox and Nintedo Wii, mobile platforms like Playstation Vita or Gameboy, mobile phones and tablets being able to run games of high quality graphics and computers are machines that someone can use in order to play video games. The rapid growth of technology has lead to big innovations like virtual reality projects which are ready to be on the market and some augmented reality games that have already been out there like Pokemon and made a real buzz on the gamers community.

Affective gaming will absolutely play a really important part in the near future combined with technologies like virtual reality and augmented reality. Many different devices have been developed but the affective gaming is not still a part of the gamers comfort to be used. Since every machine that has been created is not easy to use, like the Kinect sensor which was created by Microsoft and did sell a lot (it was obligatory to be with Xbox 360) did not make that big impact in the gaming industry. Games that exist in the market and are successful are depended on the plot of the game and story goes by.

Somehow due to the fact that most games have a well written story there is actually no need to measure emotions to those games since the fulfil exactly the goal they were created to do. Also with current methods it is really hard for developers to achieve a combination in the emotions of every user and have the correct game plot created for each and every one them. Since every human is different most of the emotions are being

expressed differently. Imagine that even for a human it is difficult to understand the emotions of other humans. Human expression detection needs a lot of work and programs before being accurate need to collect a lot of data just for the user who is about to use them. Also with players who know that they are being tracked do not express as they were supposed to and this does not provide the correct results. Creating algorithms and technologies that will be able to detect human emotions and manage without making them uncomfortable, like cable connected or facing towards a camera, but will position themselves as they want and not be abstracted by other parameters is the key to deliver the best results of the affective gaming technology.

For a gamer playing in front of the Kinect is a difficult task. Gamers want freedom while playing and Kinect although it may seem that it provides that to the user it actually does not. Forcing the player stay in front of the camera is not that easy. Especially a mobile player. The cost of the Kinect device and the additional cables needed to connect the Kinect device with a windows computer adding to this that it cannot run on a mac, is make the use of the Kinect harder. The need of a USB 3 port and a well-built computer with graphics card in addition to the missing good game titles make the reason to buy it even lower since the Xbox one decided to be sold without it. The initial goal of this project was to create a game that will change through human emotions and signals. In a way it was successful since it did work and human data were passed through the Kinect to the mobile game. But most of the players although they found it fun they did not believe they changed the game plot with their emotions but they used the Kinect as a kind of testing controller to check what changes will happen in the game. Making it work as a bigger concept that every game can get those data as input through a server is really interesting and promising, especially when the technology of the next “Kinect” will offer better results than the current generation is. The game will be published on the app store when it will have all of its finishing phases completed, since extensive testing must be made in order to have the greatest results regarding the latency of the multiplayer mode, the matchmaking to be balanced based on same level opponents and when the copyrighted assets that will be included in the game like hero sprites and emoji’s licenses are ready.

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