VR SYSTEM FOR BURN VICTIMS

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1. Problem Definition and Project Scope

Health is the most important aspect of the life of every individual and this is why it is extremely essential to take care of it. Unfortunately, not always, does our health depend on us because accidents or tragedies happen. In the current society, there are an increasing number of accidents or war victims that are left with scars for their rest of their lives, affecting both the physical and mental health.

One of the most common types of patients coming through the doors of hospitals are burn victims. They can be victims of dangerous fires, common household accidents or war victims. The consequences of those burns are categorized into several types of burns, numbered by the seriousness of the injury. Although, plastic surgery is the main solution for such terrible cases, it only solves the physical point of view of the problem. Treatments can be very painful and the patient has to endure more pain that he is already feeling with the purpose that in the end all the injuries are cured. Here is where almost no one thinks about the psychological state of the patient. The idea of having to endure so much pain can have multiple repercussions on the mind of the person under that specific treatment or medical procedure.

It is known that the mental conditions of a patient have a lot of influence on the physical one as well. Even though society is fully aware of this connection between the two parts of an individual's composition, in most of the cases, the mental one is neglected. In addition to the high demands of rehabilitation, patients must deal with social stressors including family strains, return to work, sexual dysfunction, change in body image, and disruption in daily life. Many people continue to have vivid memories of the incident, causing distress. Patients may also develop symptoms of depression. There is evidence that adjustment to burn injuries improves over time independent of the injury size. Social support is an important buffer against the development of psychological difficulty.

The good news about this issue is that it is starting to raise awareness among the medical personnel and their patients. This is the reason why a lot of studies have been performed in order to search for ways of reducing any amount of unnecessary pain during recovery treatments.

A burn injury and its subsequent treatment are among the most painful experiences a person can encounter. The emotional needs of patients with burns have long been overshadowed by the emphasis on survival. Patients undergo various stages of adjustment and face emotional challenges that parallel the stage of physical recovery. Adjustment to a burn injury seems to involve a complex interplay between the patient's characteristics before the injury, moderating environmental factors, and the nature of the injury and ensuing medical care. Psychological burn care parallels physical care and can be broken down into stages: critical, acute (first 3 months), chronic or subacute (after the first trimester), and delayed (greater than 6 months). Psychological symptoms range from mild, such as fear, sadness, uneasiness, worry, and lack of self-confidence, to severe, like depression, anxiety, delirium, and posttraumatic stress disorder. Adjustment is not necessarily directly affected by burn severity but may be related to its visibility.

Another decisive information that is worth mentioning is that technology plays a crucial role in the development of healthcare domain. The future of healthcare is shaping up in front of our very eyes with advances in digital healthcare technologies, such as artificial

intelligence, VR/AR, 3D-printing, robotics or nanotechnology. In medicine and healthcare, digital technology could help transform unsustainable healthcare systems into sustainable ones, equalize the relationship between medical professionals and patients, provide cheaper, faster and more effective solutions for diseases – technologies could win the battle for us against cancer, AIDS or Ebola – and could simply lead to healthier individuals living in healthier communities.

Health information technology (health IT) includes various set of technologies that transmit and manage health information for the groups in medical care. Generally, the term includes the capture, use, storage and/or transmission of health information through electronic processes. The potential for IT to have an impact on the safety, cost, and quality of medical care, has never been greater. Health IT is an umbrella term to describe the fully management of health information across the computerized systems and its secure exchange between consumers, providers, government and quality entities, and insurers. Generally, it is viewed as the most promising tool to enhance the quality, safety and efficiency of the health delivery system.

VR provides a simulated environment to interact with the 3D world. Medical professionals are developing and implementing this technology for training, diagnosis and virtual treatment during a critical situation.

Getting back to the main issue presented previously and taking into consideration the advantages of technology currently present in our society, one of the most feasible solutions for improving the mental health of patients suffering pain from either treatments or burns is presented in the following sections.

This solution is about creating a system that places the patient in a virtual environment specially designed in order for the user to believe that he or she is really in that environment by having interaction with objects and seeing and hearing features of the system which are very close to reality. The main purpose of this application is to decrease the amount of pain a patient can suffer from, using the connections of the brain. In other words, if the user’s eyes and ears will detect something very similar with reality, this can trick the brain in order to believe that he or she is really in that virtual environment.

In the case of burn victims, it is known that surroundings which can induce the idea of coldness are helpful in the treatment of the injuries of this kind. Because of this coldness, cognitive processes are being triggered. The said processes will give the patients the perception that the pain is not as insupportable as they believe. If the injuries are new, they will feel that their skin is not as hot and painful as it actually is.

2. Current Approaches and Technologies

a. Current Approach

As briefly described previously, the current approach for solving the issue presented is related to the cognitive state of the patient. By using the technology available in the current society, a system that helps improving the emotional and physical health of burn victims will be designed and implemented.

The manner in which we are planning to implement this application is by using the help of Virtual Reality sets. The reason why we are choosing this is because it is proven that Virtual Reality is the most efficient way to transpose someone into different, hard to physically arrive to, places or circumstances.

Pain management in burn patients is primarily achieved by potent pharmacologic analgesics (e.g., opioids), but is necessarily complemented by nonpharmacologic techniques, including distraction or hypnosis. Immersive virtual reality provides a particularly intense form of cognitive distraction during such brief, painful procedures, and has undergone preliminary study by several research groups treating burn patients over the past decade. This technique appears applicable to a wide age range of patients and may be particularly well-adapted for use in children, one of the most challenging populations of burn victims to treat.

The approach we are proposing is a game which brings the user into a cold environment surrounded by objects and animals specific to such kind of climate. The idea of coldness is brought to patient's eyes and ears by the fact that the medium is monopolized by whiteness and animals unique to cold climates like polar bears, penguins, polar foxes and wolves and seals. Having such characteristic features present in the virtual reality we are proposing, the patient will get rid of a significant amount of pain while he or she is using the system.

b. Available Technologies

For implementing the system, we make use of the availability and features of the Virtual Reality sets. The origins of immersive VR in the treatment of burn injuries arose from the recognized need for improved nonpharmacologic analgesia in this challenging acute pain setting. A variety of cognitive–behavioral therapies (including distraction, imagery, biofeedback or hypnotic analgesia provided by trained staff) have previously been employed to help patients escape the brief, yet intense, pain that accompanies burn wound care and post-burn rehabilitation activities. In its simplest forms, distraction can be achieved through audio stimulation (e.g., music), audio–video stimulation (e.g., television) and/or user interaction (e.g., video game), and theoretically helps prevent patients from focusing their attention on the painful procedure, thereby reducing the pain experience associated with the nociceptive signals still generated during the procedure. The most popular theory is that VR effectively competes for a large fraction of a user's fixed amount of conscious attention, distracting the user's focus away from simultaneous nociceptive input (e.g., from a painful medical procedure) and replacing it with more pleasant sensory input from the virtual experience.

Compared with standard of care (i.e., pain medications with no VR) researchers consistently find 30% to 50% reductions in pain ratings when VR is used adjunctively with opioids during civilian severe burn wound care and physical therapy. In addition, analog laboratory studies using fMRI brain scans have shown large reductions in pain-related brain activity associated with VR analgesia. Immersive VR has the potential to decrease suffering for US casualties with combat-related burn injuries who must undergo frequent (e.g., daily) painful wound de-bridement and rehabilitative procedures. VR is typically used adjunctively, in addition to any pain medications the patient is already receiving. One case study has recently reported VR analgesia while treating soldiers with combat-related burn injuries, but to date no controlled studies on this important topic have been published.

The use of VR to treat acute, procedural pain associated with burn injuries has steadily increased over the last decade. The pioneering preliminary studies discussed above demonstrate the potential analgesia efficacy of VR in this clinical setting, but are significantly limited by their small sample sizes and their focus on short-term outcomes of subjective pain reports. As such, these studies demand extension and elaboration to better determine the precise role for VR analgesia, not only in this clinical setting, but in the many other procedural pain settings encountered in modern medical care.

VRT (Virtual Reality Therapy) brings clients face-to-face with their deepest fears in a nonthreatening environment. That is the key. Entering a computer-generated world, clients know the situation is harmless, yet the re-creation of fearful scenes is lifelike, enabling them to deal with their fears in a realistic setting, confronting them through sight, sound, and touch. VRT is similar to behavior therapy in its focus on exposing clients to fear-provoking stimuli. It differs from traditional behavior therapy modalities in that VRT computer graphics and various display and input technologies create real-life situations in the laboratory. These produce a sense of presence, so that the client feels immersed in the frightening scene. VRT can overcome some of the difficulties inherent in traditional treatment of psychological disorders. In traditional therapy, the therapist often has to imagine what is going on in the mind of the client. In VRT, the therapist can see how a phobic client reacts to fearful situations and is able to provide on-the-spot guidance. VRT generates stimuli of much greater magnitude than standard in vivo techniques can produce. It offers the added advantage of greater variety, efficiency, and economy in creating situations that might be either difficult or impossible with traditional techniques.

After having a general idea about how useful the VR is in resolving this type of medical problem, we are going to briefly present more explicitly how the immersive environment is created. Among the vast number of programming languages, our focus is put on C#. C# is a strongly typed object-oriented programming language. This language is open source, simple, modern, flexible, and versatile.

C# is a simple, modern, and an object-oriented programming language. The purpose of C# was to develop a programming language that is not only easy to learn but also supports modern day functionality for all kind of software development. If you look at the history of programming languages and their features, each programming language was designed for a specific purpose to solve a specific need at that time.

C# language however was designed to keep business and enterprises needs in mind. C# language was designed for businesses to build all kinds of software by using one single programming language. C# provides functionality to support modern day software development. C# supports Web, Mobile, and app development needs. Some of the modern-day programming language features C# supports are generics, var types, auto initialization of

types and collections, lambda expressions, dynamic programming, asynchronous programming, tuples, pattern matching, advanced debugging and exception handling, and more. C# language syntaxes are influenced from C++, Java, Pascal and few other languages that are easy to adopt. C# also avoids complexity and unstructured language features.

Perhaps the greatest advantage is how much time a person can save by using C# instead of a different programming language. Being that C# is statically typed and easy to read, users can expect to spend less time scouring their scripts for tiny errors that disrupt the function of the application. C# also emphasizes simplicity and efficiency, so programmers can spend less time writing complicated stacks of code that are repeatedly used throughout the project. Because of the strict nature of how static codes must be written, C# programs are reliably consistent, which makes them much easier to adjust and maintain than programs that are written using other languages.

Nonetheless to say that C# is being used in this case only for the functionalities of the system. Regarding the design and how these said functionalities are being corelated with what the user actually sees, the Unity Game Engine is utilized for the eye-catching component of the application.

As a game engine, Unity is able to provide many of the most important built-in features that make a game work. That means things like physics, 3D rendering, and collision detection. From a developer's perspective, this means that there is no need to reinvent the wheel. Rather than starting a new project by creating a new physics engine from scratch– calculating every last movement of each material, or the way light should bounce off of different surfaces. What makes Unity even more powerful though, is that it also includes a thriving "Asset Store." This is essentially a place where developers can upload their creations and make them available to the community.

Unity is cross-platform which means that it is just as easy to create games for iOS, PC, or even games consoles. Another way of looking at Unity is as a game production central workflow station: developers, game designer, graphical designers, modelers, audio guys all get to send their things to Unity in a quite comfortable way. Unity also offers excellent VR support for those developers interested in developing for the Oculus Rift or HTC Vive.

Given the complexity of the game matter, for any general tool there is always the problem that on one side for whatever you will do, there will be a more specialized, harder to use and more powerful tool, and on the other, your tool is useful because it covers all aspects of game making. Keeping a balance between two sides must not be easy, and in Unity this is mostly done by allowing progressive enhancements.

To conclude, Unity facilitates agile game creation, allowing continuous releases and quick prototyping, once you got the gist of how it works.

3. Stakeholders and their needs

First of all, a stakeholder represents a party that has an interest in a company and can either affect or be affected by the business. Stakeholders can be internal or external to an organization. Internal stakeholders are people whose interest in a company comes through a direct relationship, such as employment, ownership, or investment. External stakeholders are those who do not directly work with a company but are affected somehow by the actions and outcomes of the business. Suppliers, creditors, and public groups are all considered external stakeholders. Stakeholders are important for a number of reasons. For internal stakeholders, they are important because the business's operations rely on their ability to work together toward the business's goals. External stakeholders on the other hand can affect the business indirectly. For instance, customers can change their buying habits, suppliers can change their manufacturing and distribution practices, and governments can modify laws and regulations. Ultimately, managing relationships with internal and external stakeholders is key to a business's long-term success. In other words, the stakeholder is a person or a group that has a connection with the entire process of implementation of the system, as well as with the results provided by the said system.

In this case, we can say that the primary stakeholders are the patients with burn victims and their relatives and doctors due to the fact that they are both directly and indirectly involved in this project. Speaking about people who are affect by this project and its outcomes, we can easily distinguish again the patients but also the entire health system. The success of this initiative can represent an important development in the medical care domain from which a lot of participants in this area of work can beneficiate. Moreover, from the project's success can have an influence on the sponsors because they can gain or lose from their involvement in this activity depending on how successful the program is. Also, the successfulness of the system is the desired by other stakeholders who are represented by researchers, developers, team project due to the fact that they all participate in the development of the system. It is needless to say that there can exist people who do not want a positive outcome from this project and they are characterized by the competitors. Another type of stakeholders is defined by the suppliers namely the VR system shops, hospitals and clinics that offer the circumstances for a good functionality of the project. The legal aspect of the project is covered by the health minister which manages the entire health domain of a specific community.

4. System Requirements

Singularly, a requirement is a singular documented physical or functional need that a particular design, product or process aims to satisfy. In order to have a clear image about what requirements should the system satisfy, we took into consideration the FURPS model of classifying software quality attributes and also the two known categories of requirements (functional and non-functional).

Speaking about the functional requirements, we distinguished some activities the user will have the ability to perform while utilizing the system. He or she will be able to connect to a VR set, to have the sensation that he or she is walking, having interaction with object or animals, listening to background music in a cold virtual environment.

In terms of the non-functional requirements, the system has to fulfill the following requirements: accessibility (can be used not only for individuals with burn victims but also with other mental issues), availability (only by using the VR set), maintainability (will give the same or better performance after usage), privacy (no one can interfere with the user experience), software portability (can be used in different hospitals or clinics), scalability (multiple computers can endure the application at the same time) and usability (it servs its purpose of helping the patients in need).

5. Planning Approach

Any project of this dimensions needs a very thorough planning in order to make sure that every need of the stakeholder is fulfilled along with the expected functionalities. In the case of this planning, we operated with a number of System Engineering methods and tools with the scope of generating different essential concepts.

It is worth mentioning that we exploited the benefits given from a number of diagrams in UML. In the annexes, we attached all of them namely: Requirements Diagram, Gantt Chart, WBS, Ishikawa Diagram, Activity Diagram, Sequence Diagram, Block Definition Diagram and Internal Block Diagram. With each of these models, we revealed details of how the system will function, what are the components that construct it and what activities can be performed by using the project.

In each of these diagrams, we manipulated numerous items offered by Visual Paradigm for SysML like blocks, connectors for association and inheritance and ports.

6. Challenges and Issues

It is needless to say that every process of implementing a project of these dimensions and importance, especially talking about a field of domain as important as the health one is, challenges and issues will appear expectedly or not.

For this particular system, the main challenge is to create the adequate environment that can produce the psychological effects desired. The solution for this was research among specialized doctors in the domain of mental treatment for burn victims. This was made in order to understand what are the factors that trigger certain cognitive connection that will have as a result the improvement in pain management while actually dealing with unsufferable pain from the injuries.

Another issue that appeared were the risks of which the system could have been damaged from. As you will be able to see from the risk management plan attached in the Annexes, there are number of things that could have an unpleasant effect but all of them can be resolved. Each risk is identified in such a way that team knows what is the certain risk about, in which phase of the project is placed and what triggers it. After that, they analyzed from two crucial points of view: qualitative and quantitative. In this part, computations are being made in order to find out how much can the risk damage the project with respect to time and money and also to see how likely is for that specific risk to happen. Following this, responses strategies are being searched and found with the purpose of being implemented by the team members of the affected area and checked at some period of time decided depending on the gravity of the effects. In the created management plan, there are also the risk that were already taken care of or that are not a current problem but can appear at any time in the future.

7. Quality Assurance Plan

For any kind of system to be successful, it requires to offer a certain level of quality in order for the user to trust that specific product and to use it and no other competitors. This is the reason why the quality assurance plan is made: to assure that the resources that are available are enough to provide the level of quality necessary and expected at the same time. Quality metrics are a key component of an effective quality management plan and are the measurements used in ensuring customers receive acceptable products or deliverables. Quality metrics are used to directly translate customer needs into acceptable performance measures in both products and processes. From the metrics that we took into consideration the Overall Equipment Effectiveness and Schedule Realization can be distinguished.

Regarding the Overall Equipment Effectiveness (OEE), it is an important measure of productivity and efficiency, calculated in simple terms as availability multiplied by performance and quality. It is composed from 3 parts: Availability, Performance and Quality, each of them having a specific formula to calculate their values presented below.

$$\text{Availability: } \left[\frac{(Total\ time\ available - breakdowns - changeover)}{Total\ time}\right]$$

$$\text{Performance: } \left[\frac{(Total\ number\ of\ parts\ manufactured)}{(Available\ time\ x\ production\ rate)}\right]$$

$$\text{Quality: } \left[\frac{In-specification\ parts}{Total\ parts\ manufactured}\right]$$

Fig. 1: Formulas for OEE

For those values to be found, the developers and suppliers have to be addressed to in order to see how qualitative and performed the VR sets and if the system has any problems of availability in terms of time effectiveness. If there are issues with these components and the metrics results turn out to be under the expected outcomes, then the usability and purpose of functioning of the system will be damaged.

The data that is needed for the computations is gathered by testing the system on different types of VR sets. For example, the VR sets are tested against the same simulator and the VRs which do not fulfill certain standard characteristics about time to respond to commands, user experience quality and graphics, have to be send back to manufacturer.

Another quality metrics specified is the Schedule Realization. This metric tells you how often your system reaches number of customer orders over a given period of time. A simple calculation is orders completed by scheduled date divided by total number of orders.

$$Schedule\ realization = \frac{Orders\ completed\ by\ scheduled\ date}{Total\ number\ of\ orders}$$

Fig.2: Formula for Schedule Realization

The main issue with this metric is that it involves every stakeholder implicated in the development of the system. Thus, the people implicated in the computation of this metric are suppliers, developers, researchers and the entire team of the project. Moreover, the aspects affected by a decrease in this schedule realization factor are the costs, the reliability of the customers and future number of orders.

Also, data has to be gathered in order to calculate an accurate metric. This is done by keeping track of the number of orders over certain periods of time. These periods can vary from one week or a couple to an entire month, depending on the product. In our case, two weeks is an ideal milestone to see the changes for this project. On the other hand, if any delay is being made in the development process, automatically the orders will be also delayed which will implicate a loss of money and customer trust.

8. Conclusions

In conclusion, the reason why such a system is needed in the medical field of activities in the current society, is that the mental health of any patient is not sufficiently taken into consideration when they are treated for any kind of medical problem, especially burns. Because of the appearance of more and more physical diseases that benefit from the attention of doctors and other medical personnel, the psychological health is left with little to no care at all. Tragedies that leave victims with burns, can have as a consequence the appearance of anxiety, depression and other mental syndromes that can be as damaging as the physical ones.

It is known that Virtual Reality helps improving such kind of conditions It is difficult to comprehend all the needs of the patient with burns. Caring for these patients can be a daunting task because the psychological demands of the patient remain long after the physical aspects of the burn are resolved. The challenge comes in developing a plan of care to address the complex psychological needs of each patient with burns. Nurses must venture into resources that may not be readily available to apply therapeutic intervention. Psychosocial issues in the burn patient are profound. Psychological recovery parallels physical recovery

This is what we implemented in the presented system. The application described above is different from any other ones available at this moment on the market due to the fact that it targets a specific condition and has been researched among a significant number of specialists in this domain. Moreover, the graphics of the application favorize pain reduction in a short amount of time.

9. References

- The Medical Futurist. (2020) 10 Ways Technology Is Changing Healthcare https://medicalfuturist.com/ten-ways-technology-changing-healthcare/

- M. Javaid & A. Haleem.(2020). Virtual reality applications toward medical field. *Clinical Epidemiology and Global Health*,8(2), 600-605. https://doi.org/10.1016/j.cegh.2019.12.010 https://www.sciencedirect.com/science/article/abs/pii/S2213398419304294

- M. Laal.(2013). Technology in Medical Science. *Procedia – Social and Behavioral Sciences*, 81(), 384-388. https://doi.org/10.1016/j.sbspro.2013.06.447 https://www.sciencedirect.com/science/article/pii/S1877042813015140

- S. Wiechman & D.Patterson.(2004). Psychosocial aspects of burn injuries. *ABC of burns*, 329(7462), 391-393, doi: 10.1136/bmj.329.7462.391 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC509350/

- J. Smith, K. Smith & S. Rainey.(2006). The Psychology of Burn Care. *Journal of Trauma Nursing*, 13(3), 105-106 https://www.nursingcenter.com/journalarticle?Article_ID=670628&Journal_ID=607948&Issue_ID=670606

- S. Sharar, W.Miller & A.Teeley.(2008). Applications of virtual reality for pain management in burn-injured patients. *Expert Rev Neurother*, 8(11), 1667-1674, doi: 10.1586/14737175.8.11.1667 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2634811/

- C. Maani, H. Hoffman & M. Morrow.(2011). Virtual Reality Pain Control During Burn Wound Debridement of Combat-Related Burn Injuries Using Robot-Like Arm Mounted VR Goggles. *J Trauma*, 71(10), S125-S130, doi: 10.1097/TA.0b013e31822192e2 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4460976/

- M. Chand(2020). What Is C# https://www.c-sharpcorner.com/article/what-is-c-sharp/

- (2019, May 15). Everything you need to know about C#. *Pluralsight* https://www.pluralsight.com/blog/software-development/everything-you-need-to-know-about-c-

- P. Polsinelli(2013, December 5) Why is Unity so popular for videogame development?. *Designagame* https://designagame.eu/2013/12/unity-popular-videogame-development/

- A. Sinickl(2020, June 23) What is Unity? Everything you need to know. *Androidauthority* https://www.androidauthority.com/what-is-unity-1131558/

10. Annexes

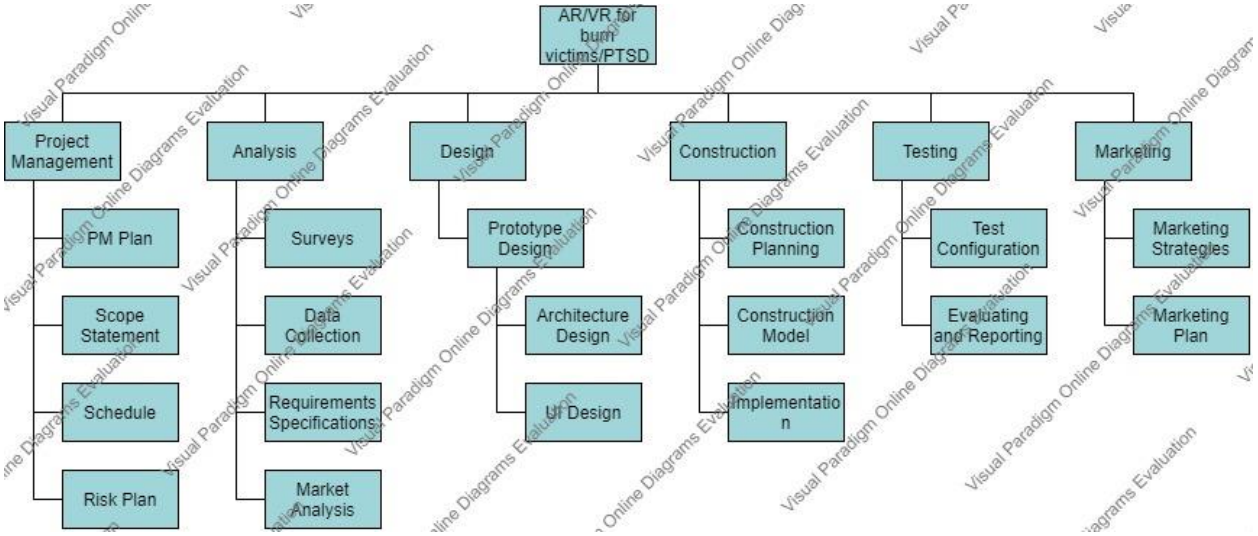

Fig. 3: WBS

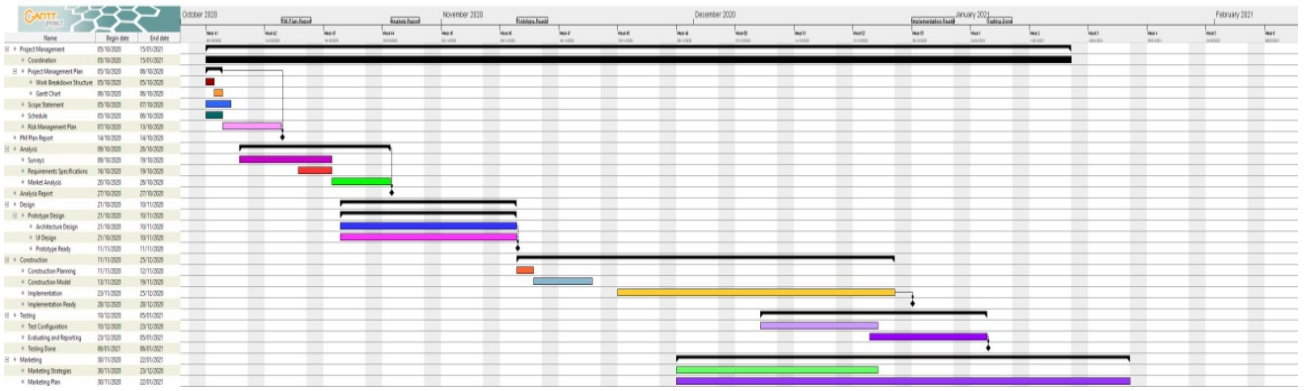

Fig. 4: Gantt Chart

Date 10.11.2020

Project Mngr Vulpe Catalina **Name:** Pain_Out

PROJECT RISK MANAGEMENT PLAN

	Identification							Qualitative Analysis				Quantitative Analysis				Response Strategy			Monitoring and Control		
Priority	Status	ID #	Date Identified Project Phase	Functional Assignment	Threat/Opportunity Event	SMART Column	Risk Trigger	Type	Probability	Impact	Risk Matrix	Probability (%)	Impact ($ or days)	Effect ($ or days)	($) =(13)x(14)	Strategy	Response Actions including advantages and disadvantages	Affected WBS Tasks	Responsibly (Task Manager)	Status Interval or Milestone Check	Date, Status and Review Comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(18)	(17)	(18)	(19)	(20)	(21)
1	Dormant		Testing	Testing	System has a side-effect on certain patients, making their state worse		Eventual bugs that are found during the use of the system in different environments	Quality	Moderate	High		50%	3	150		Mitigation	Increasing number of patients;resolving code bugs in order to be suitable for more types of environment	Implementation	Developers	7 days	
2	Active		Analysis	Analysis	The given funds could not be sufficient for implementing the system at the desired scale		The budget turns out to not be enough for all the phases of the project.	Cost	Moderate	High		50%	14	700		Transference	Finding sponsorships in time to avoid any problem, recalculate how the budget is divided	PM Plan	Project Manager	7 days	
3	Active		Analysis	Analysis	The cost of purchasing the final product can be too high in comparison with the hospitals and clinics budgets		The health care institutions may not have enough resources to buy the equipment.	Cost	Moderate	Moderate		50%	30	1500		Transference	Create special packages/bundles, in order to present them the most acceptable cost solution we can come up with	Market Analysis	Marketing Team	30 days	
4	Dormant		Testing	Testing	VR system can cause addiction for the users		Long use of the system by a certain user can be the reason for developing an unhealthy habit ending up with an addiction	Scope	Low	Low		30%	20	600		Mitigation	Implement alerts after certain hours of use and also periodiatly notifications about the risks of long-time use	Implementation	Developers	30 days	
5	Active		Analysis	Analysis	People could not find the system a suitable solution for their conditions		The mistrust of people especially the older ones in the benefits of technology in the medical domain	Scope	Moderate	Moderate		50%	10	500		Transference	Doctors and all other health care employees should advise their patients to use the system because all people have more trust in doctors than in advertising.	Marketing Strategies	Marketing Team	60 days	

Date

Project Mng: Vulpe Catalina Name: Pain_Out

PROJECT RISK MANAGEMENT PLAN

	Identification							Qualitative Analysis				Quantitative Analysis			Response Strategy			Monitoring and Control		
Priority (1)	Status (2)	ID # (3)	Date Identified Project Phase (4)	Functional Assignment (5)	Threat/Opportunity Event (6)	SMART Column (7)	Risk Trigger (8)	Type (9)	Probability (10)	Impact (11)	Risk Matrix (12)	Probability (13)	Impact ($ or days) (14)	Effect ($ or days) (15)=(13)x(14)	Strategy (16)	Response Actions including advantages and disadvantages (17)	Affected WBS Tasks (18)	Responsibility (Task Manager) (19)	Status Interval or Milestone Check (20)	Date, Status and Review Comments (21)
6	Dormant		Testing	Testing	Patients receive wrong virtual environments to see in the VR experience		Doctors do not know how to manipulate the system and offers the patient the wrong physicological treatment.	Scope	Moderate	High		50%	2 days	100	Transference	The doctors will participate to a seminar in which a tutorial of how the system works will presented in order to see exactly what abilities the system has.	Evaluating And Reporting	Testers	14 days	
7	Dormant		Design	Design	Wrong environment is created for patients and their conditions are getting worse		The design of the system does not have the appropriate characteristics in order to give patients a better feeling about their injuries.	Scope	Moderate	High		50%	7 days	350	Mitigation	After seeing the effects, better alternatives of environments will be searched and will replace the ones that are not good for future patients.	Architecture Design	Developers	10 days	
8	Dormant		Implementation	Construction	The same environment offered by the system is not suitable for every pasient.		Because the same VR environment doesn't have the same effect for adults and children, one of these categories can be badly affected from the system's usage.	Quality	Low	High		30%	15 days	450	Mitigation	Various options of treatments will be implemented in order for the doctor to have the possibility to treat all kinds of patients.	Construction Model	Developers	15 days	
9	Parked		Analysis	Analysis	Lack of cooperation from interviewed potenatial users regading the requirements of the system		Due to the skepticism of some people, there will not be sufficient data collected in order to define clear requirements for future implementation.	Quality	Low	Moderate		30%	3 days	90	Mitigation	The best way to handle this is to search for more participants which are willing to cooperate in order to get to a feasible result	Data Collection	Analysts	4 days	
10	Active		Analysis	Project Management	System is not ready in time for delivery to hospitals and clinics.		Due to unexpected challenges, the implementation is not ready in time for efficient testing.	Schedule	Low	Low		30%	5 days	150	Acceptance	In order for the system to be perfectly usable, the most appropriate way to deal with this is to get some extra time from other ongoing development processes(starting marketing before the end of testing)	Schedule	Project Manager	3 days	

Fig. 5 Risk Management Plan

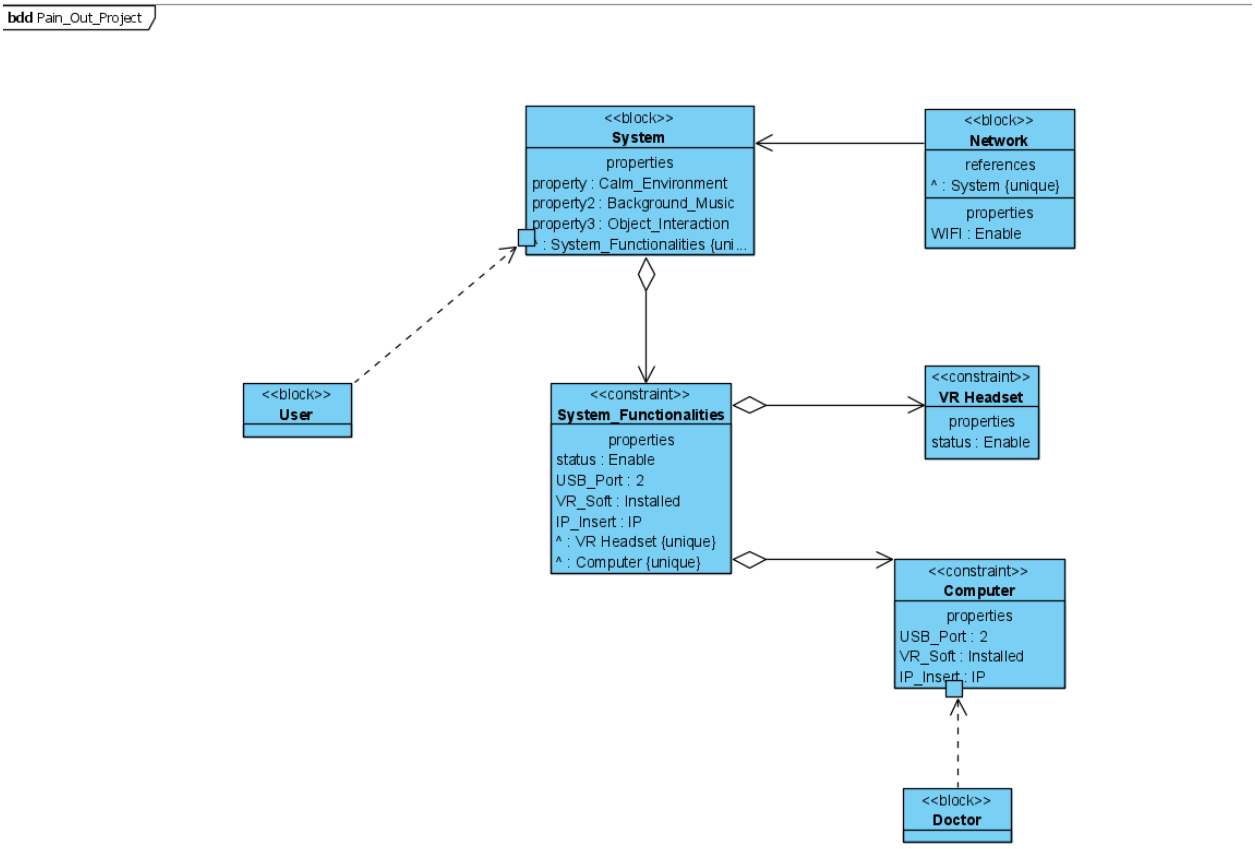

Fig. 6: Block Diagram

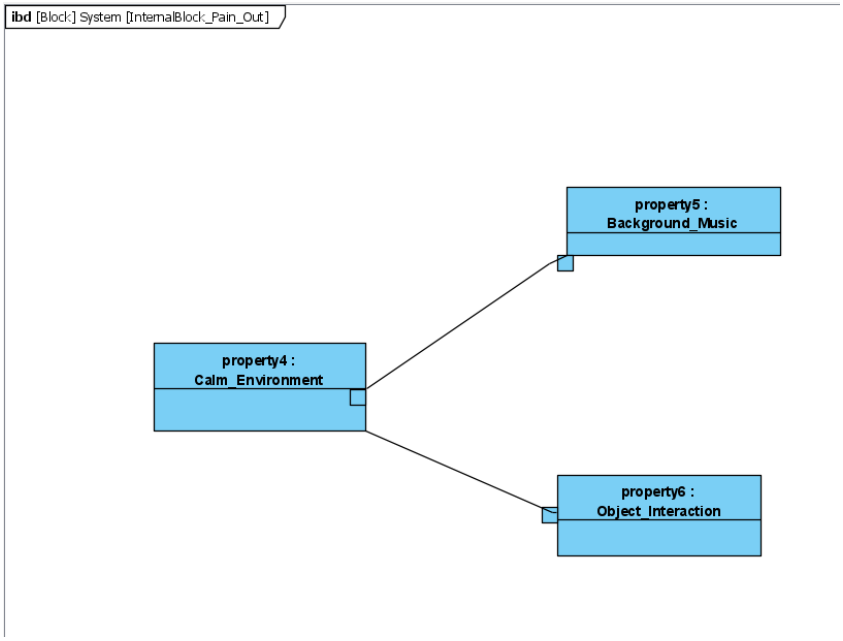

Fig. 7: Internal Block Diagram

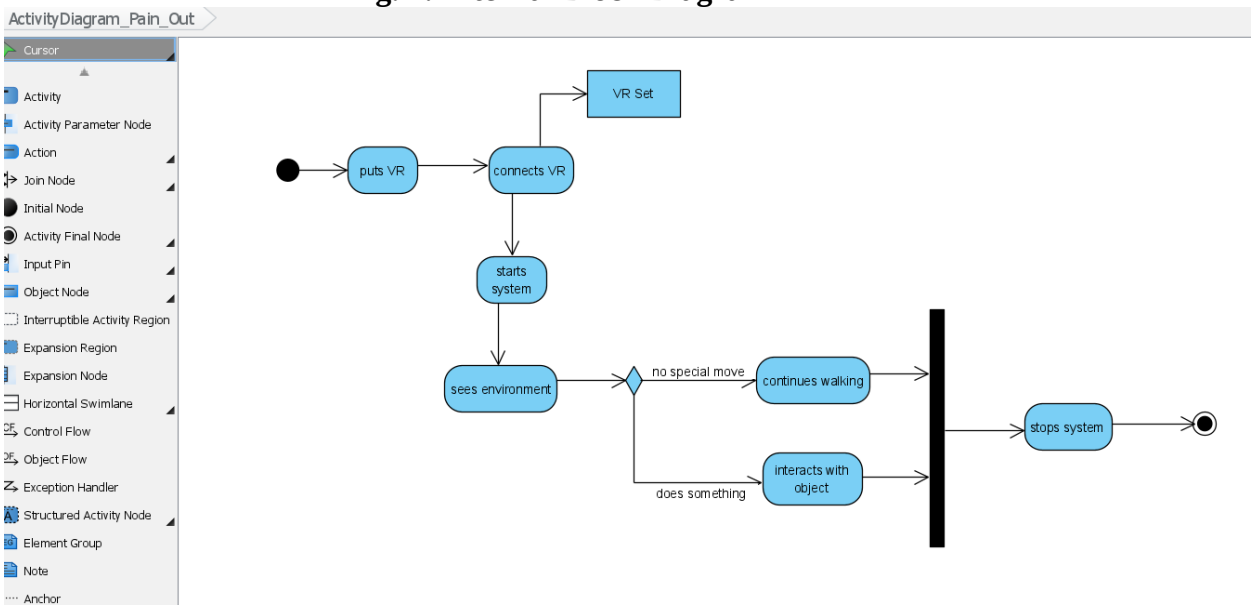

Fig. 8: Activity Diagram

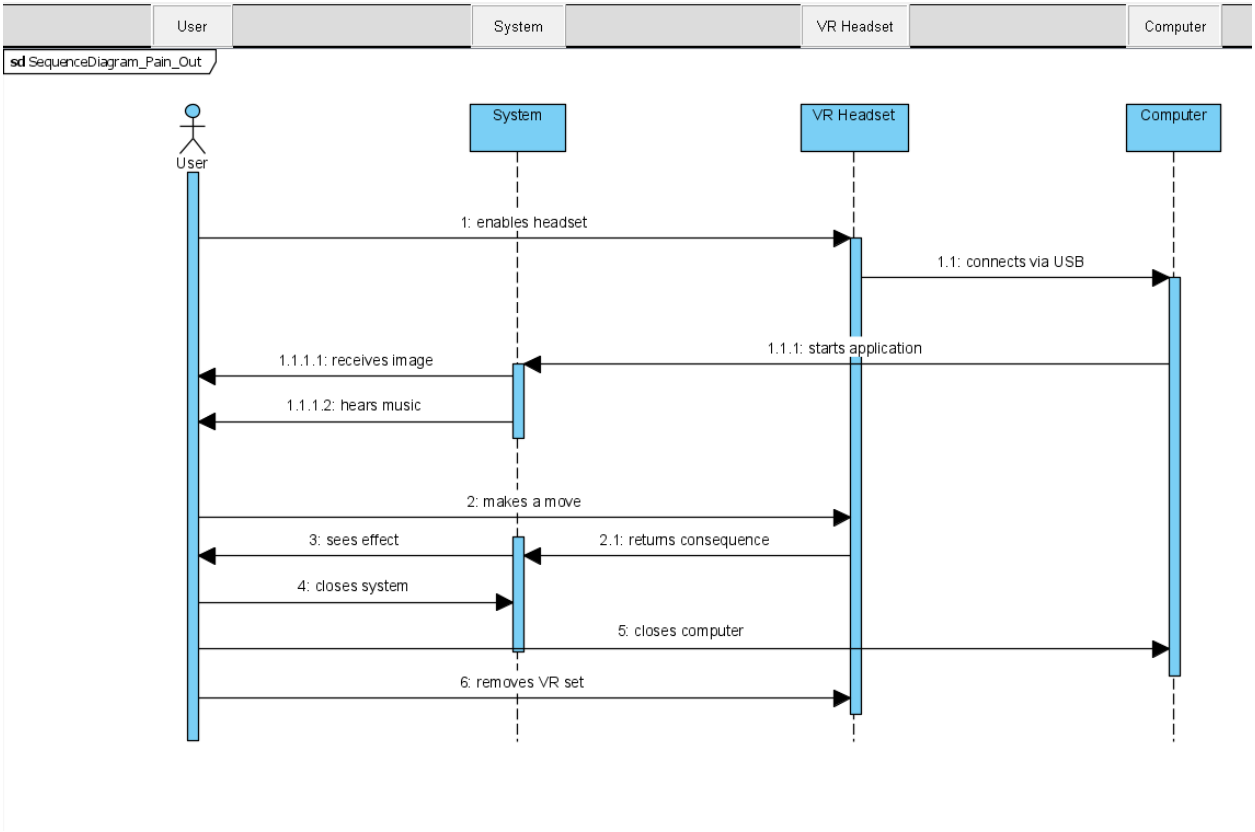

Fig. 9: Sequence Diagram

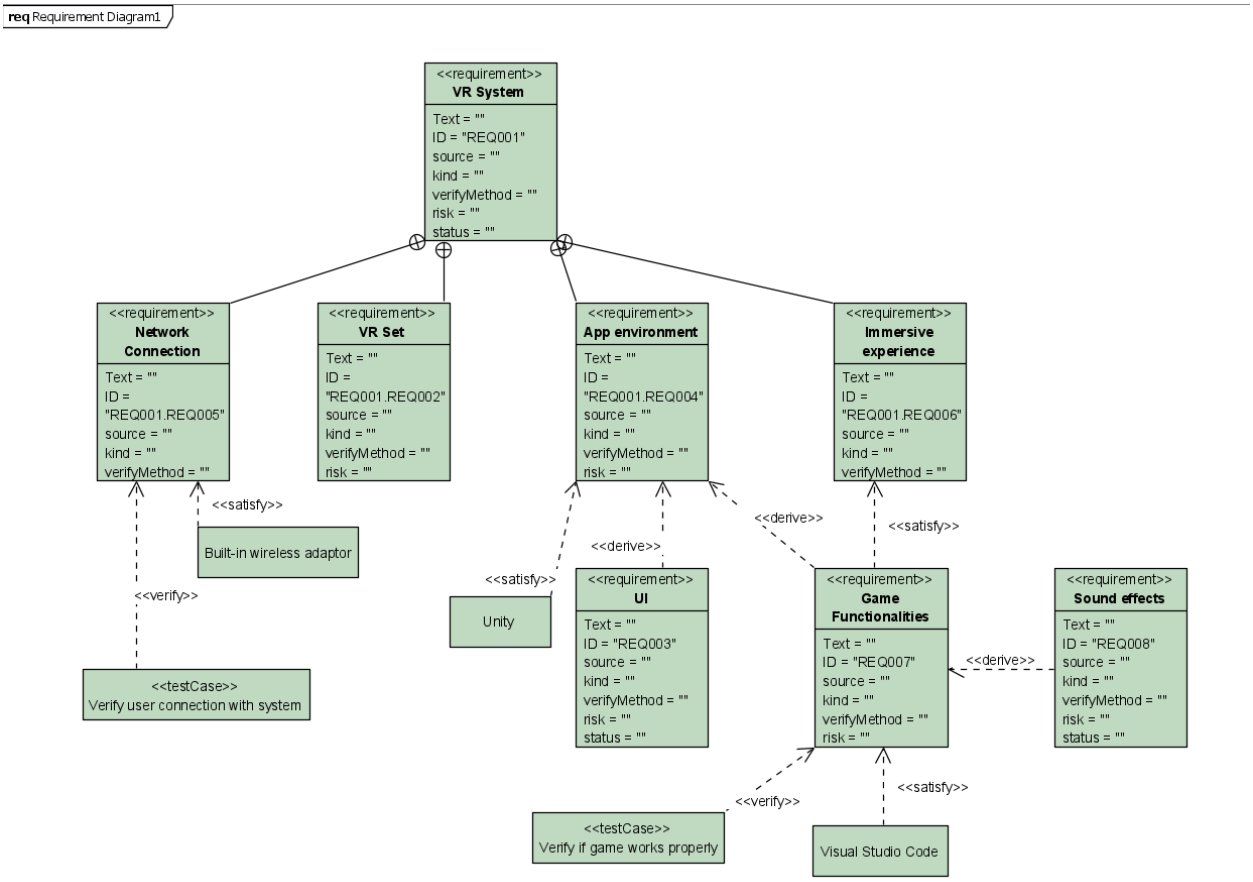

Fig. 10: Requirements Diagram