

# A Proposal for Stress Management Using Serious Games Associated to Virtual and Augmented Reality

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## ABSTRACT

Occupational stress is a serious problem that affects a large number of workers. Regardless financial or social status, age and profession, a person exposed to stress may develop health problems that can interfere with work and his quality of life. Thus, due to absenteeism and reduced productivity, companies lose money when its employees are stressed. In this scenario, it is important that employees use strategies to deal with such drawback. Coping with occupational stress can be basically achieved, in two ways: problem-focused or emotion-focused. Literature shows that strategies which take the needs of individual workers into account have a greater chance of success. On the other hand, computer games, mainly those based upon Virtual and Augmented Reality (VR/AR) techniques, offer players some experiences like: relaxation, sense of control, challenges, learning opportunities and immersion. These characteristics can contribute to the control process of occupational stress. The objective of this paper is to propose a new methodology for occupational stress, focused on emotion. In so doing, we use Serious Games and VR/AR techniques, considering particular needs of the employee.

**Keywords:** Emotional stress, Human rehabilitation, Serious games, Virtual and augmented reality.

## 1. INTRODUCTION

Stress has become a serious problem that affects many people. When we consider stress in work environment, different people, regardless financial status, age and profession can be affected causing financial damage to companies and health problems to the worker himself.

It was identified in 2000, that the occupational stress in United States was the second most common cause of workers health problems [1]. In the European Union (EU) in 2005, it was found that occupational stress was the second health problem

notified affecting 22% of workers [2]. In a survey in Brazil made by UnB (University of Brasilia) in 2011, revealed that more than 1 million workers were out of work and receiving sickness pay for problems caused by stress, depression, alcoholism and others [3].

Companies and governments spend too much money on the consequences related to stress at work. In 2002, the economic cost of work-related stress in the EU was estimated in € 20 billions [2]. In Brazil, it is estimated that the damage will be 3.5% of GNP (Gross National Product) considering faults and medical license [3].

On the other hand, when one worker is continuously exposed to stress, he can develop psychological and physical problems that affect his performance at work and also his personal life. In recent years, the relationship between occupational stress and mental health workers has been researched due to alarming levels of temporary disability, absenteeism, early retirement and health risks associated with professional activity [4].

There are several initiatives that promote events, discussions and suggest practices to cope with stress. The STRESSLESS project, started in 2010, has as main objective to develop and validate an international useful tool to combat stress in educators and educational institutions. One of the results of this project is the practical guide intervention in work-related stress [5]. Another initiative is the European Agency for Safety and Health at Work (EU-OSHA) which aims to make safer, healthier and more productive workplaces in Europe by promoting a culture of risk prevention to improve working conditions [2]. Brazil, along with other countries, participates of the International Stress Management Association (ISMA), which proposes to contribute to the orientation of technological applications for the diagnosis and treatment of stress [6].

In this context, this paper aims to describe a new proposal to cope with occupational stress using Serious Games through Virtual/Augmented Reality techniques. The work is divided as

follows: Section 2 describes Occupational Stress related to the workplace. Section 3 shows the concepts of recovery stress. Section 4 presents the concepts of coping with stress and height the difference between recovery and coping. Section 5 describes the definition of Virtual Reality and Augmented Reality. Section 6 shows the concepts of Serious Game. Section 7 presents definition of Flow theory. Section 8 shows related works and finally section 9 presents the proposal of coping with stress using Serious Game associated to Virtual and Augmented Reality. Section 10 describes de conclusions of this work.

## 2. OCCUPATIONAL STRESS

The changing in the work processes brought greater flexibility, agility and even comfort for some employees. However, for others have brought job insecurity, reduced demands of work and precarious forms of employment. Moreover, rapid technological changes and strong demands for efficiency, competitiveness and improvement in customer services form a backdrop of continuous change. In this context the pressures at work are gaining ground with the production of high levels of occupational stress.

There are several stress definitions. Some addresses the biochemical aspect of the human body, others addresses behavioral aspects and still others the internal and external conditions that can cause stress. In [7], stress is defined as an imbalance ratio between environmental demands and personal resources, in which individuals perceive demands that deplete or exceed the resources they judge available to face the situation that is assessing for them as threatening for its balance. A common point in the definitions of stress is that they characterize the stress as the body's response to certain stressors.

Aspects involving the response to stressors are cognitive, behavioral and physiological. The effectiveness of these three levels ensures the person processing stressful information more quickly. This enables them to get proper conduct on this demand and facilitates a more positive body action [8].

When stress happens in the workplace it is called occupational stress. In [9], occupational stress is defined as a product of the relationship between the individual and the work environment, in which the demands of that environment exceeds the coping skills of the worker, causing excessive wear on the body and interfering with his productivity.

Examples of factors that can cause stress (stressors) are: unfavorable physical conditions, noise levels, excess heat, wear in interpersonal relationships, poor diet, sedentary lifestyle etc.

In [10], the symptoms of occupational stress are divided into three categories: physiological, behavioral and psychological. The physiological is related to changes in metabolism. The behavioral is observed in the changes related to productivity, absenteeism, increased smoking and alcohol consumption, etc. The psychological symptoms are observed in dissatisfaction at work, stress, anxiety, instability, boredom and procrastination activities.

## 3. RECOVERY STRESS

In daily life, people are confronted with numerous requirements which make it necessary to allocate physical and mental resources for performing a task. To recover from job stress or other forms of strain, we need phases of rest that allow us to renew the physical and psychological resources that were utilized in the preceding situation [11].

Recovery refers to the processes opposite to stress and strain. It can be understood as the process of replenishing depleted resources or rebalancing suboptimal systems [12].

Probably, it is not a specific activity itself that helps to recover from stress, but its underlying attributes such as relaxation or psychological distance from stressors. Persons may differ with respect to the specific activities they experience as recovering, while the underlying psychological experiences crucial for recovery may be relatively uniform across persons. For example, one person might recover from job stress by going for a walk while the other recovers by reading a book. Although the activities are different, the underlying processes (e.g., relaxation) are rather similar [12].

In this sense, it's presented in [12] four basic feature to recovery process, namely: Psychological Detachment, Relaxation, Mastery Experiences and Control During Leisure Time.

- Psychological Detachment: implies not to be occupied by work-related duties such as receiving job-related phone calls at home or actively engaging in job-related activities. Psychological detachment can also mean to disengage oneself mentally from work. It implies to stop thinking about one's work and job-related problems or opportunities.
- Relaxation: is a process often associated with leisure activities. The potential for relaxation experiences to reduce activation and to increase positive affect are important for recovery in two respects. First, prolonged activation resulting particularly from stressful work is an important mediating mechanism by which job stressors translate into illness. Therefore, processes that reduce this prolonged activation are crucial in order to restore an organism's pre-stressor state. Second, positive emotions can undo the effects of negative emotions. Positive affect resulting from relaxation experiences will be helpful in reducing negative affect resulting from job stress.
- Mastery Experiences: refer to off-job activities that distract from the job by providing challenging experiences and learning opportunities in other domains. These activities offer opportunities for experiencing competence and proficiency. Mastery experiences challenge the individual without overtaxing his or her capabilities. Attaining mastery experiences is not necessarily effortless but requires a certain degree of self-regulation.
- Control During Leisure Time: it can be described as a person's ability to choose an action from two or more options. Here, we will focus on the degree to which a person can decide which activity to pursue during leisure time as well as when and how to pursue this activity. The experience of control during leisure time may satisfy one's desire for control by

increasing self efficacy and feelings of competence, which in turn promote well-being. In this sense, control may act as an external resource that enhances recovery from work during off-job time. In addition, control during leisure time gives the individual the opportunity to choose those specific leisure activities that he or she prefers and that may be especially supportive for the recovery process.

In [12], it is suggested that stressors at work are associated with the experience of recovery. Moreover, the experience of recovery helps control stress and consequently contributes to the psychological wellbeing of the person.

Another research about recovery reports the growing evidence that recovery experiences (psychological detachment, relaxation, master experience and control) are associated with well-being [13]. Furthermore, it discusses the importance of knowing whether these experiences can be deliberately enhanced through interventions.

#### 4. COPING WITH STRESS

Literature on stress indicates that each individual is affected differently by stress situations. Some of them are more susceptible to the consequences and others more resistant. This way of dealing with an episode of stress may include attitudes, for example, address the problem, seek social support, deny the problem or distract yourself with other things and other various strategies [14].

Thus, each person can use one or more strategies for coping with stress. This choice can be based on several factors such as: the level of stress, the type of stressors, past experience and the tools available to deal with the problem. So, coping is defined as a process by which the individual manages the demands of the relationship between person and environment that are evaluated as stressful and the emotions generated by them. Facing a stressful situation, individuals undertake an assessment of it, so the body can respond adequately to the stressor, solving or mitigating the stressful situation [15].

In [15], coping has five functions:

- To adapt the individual to situations or negative events.
- To maintain positive self-image.
- To maintain emotional balance.
- To maintain satisfactory interpersonal relationships.
- To reduce threatening environmental conditions.

In the theory proposed by [15], coping can be divided into two categories: emotion-focused coping and problem-focused coping. In the first category, coping strategies propose mechanisms capable of influencing the emotional part of the individual lowering the level of stress, such as meditation. In the second category, strategies seek to eliminate the sources of stress present in the environment, such as noise. Sometimes, it is not possible to eliminate the source of stress. So, in this cases, it is useful the emotion-focused strategies able to lowering the level of stress.

Thus, based on the theory of Lazarus and Folkman, stress can be seen as shown in Figure 1. The person is target of stress' sources (stressors). Thus, they may have a preventative

approach through a regular healthy diet, physical activity or recreation. These activities help to deal with the health consequences of stress. When the person is under stress he/she can manifest individual symptoms such as insomnia and difficulty feeding or situational symptoms, such as: low productivity at work and difficult on their relationships. To manager this situation person copes with stress. If it's possible to eliminate the source of stress, problem focused coping is used. However, most of the times it's not possible to eliminate this source of stress and sometimes it's not interesting to do so. Thus, employees use some technique or tool to act on their emotions (emotion focused coping). Therefore, it is important to offer employees many tools as possible to decrease levels of stress with emotion focused coping.

Prolonged exposure to stressors can exacerbate individual and situational symptoms prompting the person to illness. In this context, coping strategies focused on the problem are adopted to eliminate the sources of stress. On the other hand, coping strategies focused on emotion are used to decrease stress levels through cognitive activities that work with the emotional side of the person.

Coping refers to actions and strategies applied by an individual to react to stress and problem situations. Although the coping and recovery concepts certainly show some interrelations, these concepts are not identical. Accordingly, recovery refers to activities that allow individuals to regain consumed energy after work, stress, and strain, while coping primarily describes the individual's direct reaction to a given stressor [11]. So, recovery activities are done out of work place, while coping activities are done in work place.

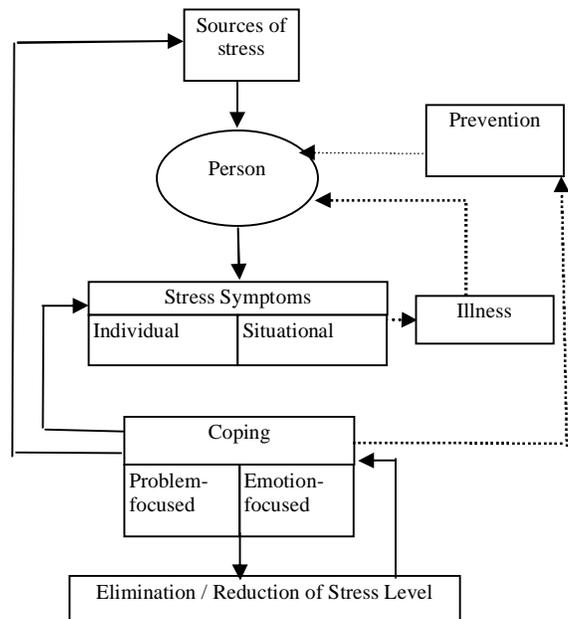


Fig. 1. Coping Stress

#### 5. VIRTUAL REALITY AND AUGMENTED REALITY

Virtual Reality (VR) can be defined as an advanced interface to computer applications, which allows the user movement (navigation) and real-time interaction in a three dimensional environment. It can make use of multisensory devices [16].

## 7. FLOW THEORY

According to [16], in the virtual environment people's sense capabilities can be expanded in intensity, time and space. This is achieved by three-dimensional modeling techniques used to build virtual objects and scenery, where the user can navigate. Thus, VR allows the user to interact with and portray imaginary situations, like the fictional scenarios involving static and moving virtual objects. Also allows to faithfully reproduce real-life environments.

One of the advantage of this interface is the possibility to use people's knowledge of real world in the virtual world. Thus, skills and intuitive knowledge can be used to deal with virtual objects.

Augmented Reality (AR) can be defined as the enrichment of the real environment with virtual objects, using some technological device, running in real time [17].

Virtual Reality and Augmented Reality can be compared as follows [17]:

- Augmented Reality enriches the scene of the real world with virtual objects, while VR is totally computer generated;
- In Augmented Reality environment, the user retains the sense of presence in the real world, while in Virtual Reality, the visual sensation is controlled by the system;
- Augmented Reality needs a mechanism to combine the real and the virtual, while Virtual Reality needs a mechanism for integrating the user to the virtual world.

Beyond the capacity of involvement, motivation and interaction also present in Virtual Reality, the use of Augmented Reality provides the possibility of enriching real world scenes with virtual objects. This feature allows systems to use Augmented Reality using known scenarios for the patient, which may be useful in certain therapies, such as physical rehabilitation.

## 6. SERIOUS GAME

In [18], it is described that serious game have a purpose beyond entertainment, including (but not limited to) learning, health, advertising and social changes. According to [19], the term serious games has become used to identify games for a specific purpose, i.e., to go beyond the idea of entertainment and offer other types of experiences, such as those related to learning and training.

In this sense, serious game using the known approach in the gaming industry can make simulations more attractive and even entertaining. It offers activities that promote the absorption of concepts and psychomotor [19].

These features are important in healthcare such as: to motivate a patient to do repetitive exercises provide training tools for health professionals, provide environments/tools for treatment at a lower cost or in remote locations.

It is clear, therefore, that a serious game is a special purpose application, which requires support from professionals in the field to which the content is related.

According to [20], the concept of Flow was introduced by Mihaly Csikszentmihalyi in the mid-70s in one attempt to explain happiness. Furthermore, Flow is a feeling of complete focus and stimulated in an activity with a high level of enjoyment and satisfaction.

During the experience of Flow, we lose the notion of time and worry. In fact, our level of focus maximizes our performance and feelings of pleasure from the activity [20].

Descriptions of the experience of flow is identical to those that players experience when immersed in games, losing track of time and external pressure, along with other interests [20]. So, industry of games uses Flow theory to develop good and interesting games. When a player is in flow, it means that the game got a good balance between challenge and skills. Thus, feelings like anxiety and boring are avoided.

## 8. RELATED WORK

Technologies that enable user interaction have characteristics that can be used to assist the coping strategies of stress, among which stand out: Augmented Reality, Virtual Reality and Serious Games (SG). The main characteristics of AR and VR are: immersion, engagement and interaction. Moreover, the solutions using AR combine a 3D visual interface and tracking system for the alignment of real and virtual objects. Recent research also shows the power of gaming technologies to support virtual communities and distributed training groups to explain concepts and to engage and motivate people.

These technologies have been used in the area of physical rehabilitation and coping with post-traumatic stress. Some papers present AR systems to assist in human rehabilitation. These systems have AR as one of the main technologies used to develop the solution. For example, in [21], it is proposed a training environment incorporating AR in a set of devices, developed to extension fingers rehabilitation.

Beyond Augmented Reality, Virtual Reality is used in [22] to describe a solution developed to help patients during the learning phase of the use of upper limb prosthesis, without actually having to use the prosthesis.

Other works propose the use of gaming technology to assist in physical rehabilitation. For example, in [23], it is proposed a game system (NeuroGym) based on biofeedback. This system can be used to improve muscle activation and gait pattern of a patient with spinal cord injury. The training with NeuroGym also improved the balance in a group of older adults.

In [24], it is shown the implementation of a system for capturing full body movement (MoCap), which together with a biosignal acquisition device was incorporated into a game engine. The study authors have implemented a serious game aimed at the rehabilitation of patients with chronic low back pain and neck pain.

It is clear, therefore, that the technologies of AR, VR and SG are being researched to support the recovery process of people who have suffered some kind of trauma. The characteristics of engagement, immersion and motivation mean that they can be

used in the development of tools that help people in the recovery process.

On the other hand, surveys conducted so far show that technologies as AR, VR and SG together has not been explored yet, as a whole, as a unique tool to support coping strategies of stress at work. In [25], it is proposed a framework that allows the identification and prediction of stress-generating activities. However, when identified the occurrence of a stress-generating activity, the framework proposes as coping strategies three options: The postponement of the task, a better preparation for the completion of the task or the time to perform some activity that the person considers relaxing. It didn't address the use of technology in coping strategy.

Virtual Reality is used in occupational context in the INTERSTRESS project. It aimed at developing innovative ICT-based solutions for addressing the problem of psychological stress in professional and social life [26]. From a technological standpoint, the project involves a combination of Virtual Reality, non-invasive biosensors and mobile tools to provide personalized healthcare devices for stress prevention and management. The specific objectives of this approach are:

- quantitative and objective assessment of symptoms using biosensors and behavioral analysis;
- decision support for treatment planning through data fusion and detection algorithms;
- provision of warnings and motivating feedback to improve compliance and long-term outcome.

It is presented in [11] a study about the use of games to recovery stress at work. This study proved by statistical data that the use of computer and video games are effective in combating stress. However, the research did not propose a systematic way for the use of games in coping with stress. Furthermore, the research was done with normal games, or games that are not designed for the purpose of coping stress.

The effectiveness of using casual video games to improve mood and lower the level of stress is also researched and proven in [27]. Some research studying video games as sources of stress and others explore the benefits of games in healthcare in general.

## 9. COPING USING SERIOUS GAMES

We group the researches on occupational stress into a few topics as presented in Figure 2, namely: Stress Measurement; Observation of Activities Performed; Stress Pattern Identification (stressors); Stress Prevision; Coping Strategies and Evaluation.

The relationship between these topics is also shown in Figure 2. The stress measurement is made during the observation of the activities performed by the employee in the workplace. This measurement can be made, for example, using sensors or questionnaires for identifying changes biological, physical or behavioral indicating whether or not the person is stressed. After identifying the activities that generate stress (stressors), we can determine pattern activities, enabling the prediction of stress situations. Information got in previous topics can help to develop coping strategies. Further, these strategies can have its efficiency evaluated.

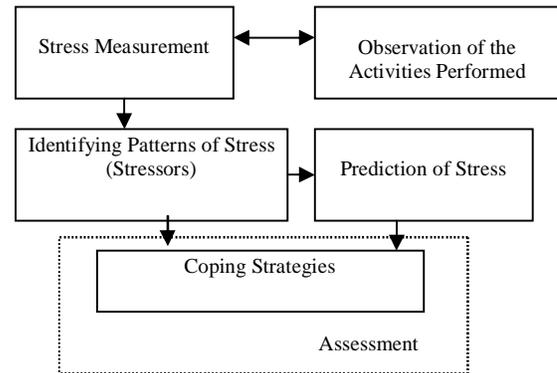


Fig. 2. Occupational Stress Topics of Study

The Occupational Health Psychology researches usually develop studies on the identification of coping strategies within the scope of a profession. This choice is made by the stressors and coping may vary between different professions. Furthermore, they can do the evaluation of the strategies identified or suggested programs of stress management. Some others researches propose protocols to measure, to evaluate or to rank the strategies that people adopt to cope with stress. The inventory coping strategies from Folkman and Lazarus [28] is one example of such protocols. It assesses the different ways people respond to stress by means of a set of items classified into eight distinct conceptual dimensions, namely: confrontation, distancing, self-controlling, social support, accepting responsibility, escape-avoidance, problem solving, and positive reappraisal.

Research in the computer area regarding occupational stress are concentrated on identifying/measuring stress using sensors that capture biological signals, sound, image or behavioral patterns. In addition, some studies, for example, in [11], discuss theoretically the use of entertainment games as a coping strategy. Other works, such as in [27], related games as a change agent in mood making the stress level decrease. Although these studies describe the use of games in coping with stress, we didn't find a strategy that uses some kind of technology, including games, systematically in coping strategies.

Serious Games differ from entertainment games because they have a purpose (specific and intentional learning) to be achieved when a person uses it. Thus, in the development of Serious Games, these goals must be observed to guide its construction.

Furthermore, video games have great proximity to Virtual Reality, because prioritize interaction. Initially, games used 2D graphics. But, with the move to 3D space, they incorporated all the features of Virtual Reality, and should be one of the biggest sectors of application of this technology [16]. Additionally, according to [29], the best way for the creation of an interactive and immersive experience is to create games that use both the content of the real and virtual world to stimulate the player so that your imagination fill in the gaps and they become truly immersed. This is possible using Augmented Reality.

So, a game interface created using VR/AR techniques can improve the interaction, motivation and immersion game characteristics.

The purpose of this work is the use of Serious Games associated to Virtual and Augmented Reality techniques in coping with occupational stress. The proposal also suggests that the Serious Games developed for this purpose should be guided by the dimensions of inventory coping strategies and the needs of the worker.

Workers' needs or characteristics must be observed to be possible to identify the coping strategies of stress that they practice. Furthermore, it allows the construction of a profile that will help in defining what types of strategies can be effective in coping with stress.

The dimensions of inventory coping strategies provide an orientation of how the game should address the coping with stress offered to the player. For example, we can develop a game that takes the player to learn or work confrontation by a way of demonstrating feelings of dissatisfaction with the problem spilling emotions.

Figure 3 shows the proposal scheme. Two distinct periods are presented: Building Moment and Application Moment. The first is the stage where the workers' profile are prepared. Furthermore, stressors and coping strategies are identified. These tasks should be observed in the context of a particular profession to guide the development of Serious Games based on the dimensions of inventory coping strategies and a worker profile. The second is the stage where the employee is suggested to use the game developed.

The Employee Monitoring, presented in Figure 3, is responsible for providing employee information to identifying stressors and coping strategies. Furthermore, it identifies when the game developed should be suggested to the employee as a tool to reduce stress levels. Thus, the proposed scheme can be part of a control program stress within a company where serious games can be used as a support tool.

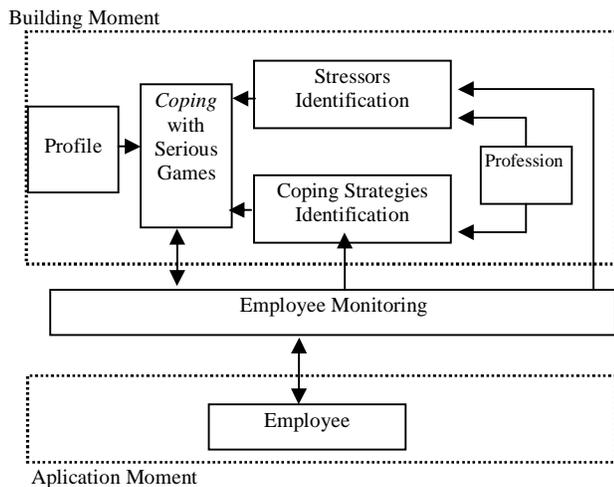


Fig. 3. Using Serious Games as Coping Support

The purpose of this work is to investigate how serious game must be constructed to face stress. First of all, the use of Virtual or Augmented Reality techniques improves the game characteristics of: immersion, interaction and engagement. Second, establish a target context. Different people react on different way from same stressor. The degree of stress can be different either. However, coping strategies can be categorized.

According to the theory of Lazarus and Folkman, these categories are: confrontation, distancing, self-controlling, social support, accepting responsibility, escape-avoidance, planful problem solving, and positive reappraisal. So, this information can be used to guide what kind of serious game will be developed. Third, to construct a people context profile, with information about: people preferences/coping strategies, context and stressors. This task can be made using psychology techniques to identifier and understand these information. Finally, we want to use the profile information, in construction phase, to get a game that is able to make the player achieve the flow Zone and stay there for the most time as possible. When the player is in flow Zone he is able to decrease the stress level. It is important to highlight that in this proposal the needs and characteristics of people are take into account to constructs the serious game. This is very important to success of any coping stress strategy. The Fig 5 illustrates the issues to guide the construction of a serious game too support coping processes.

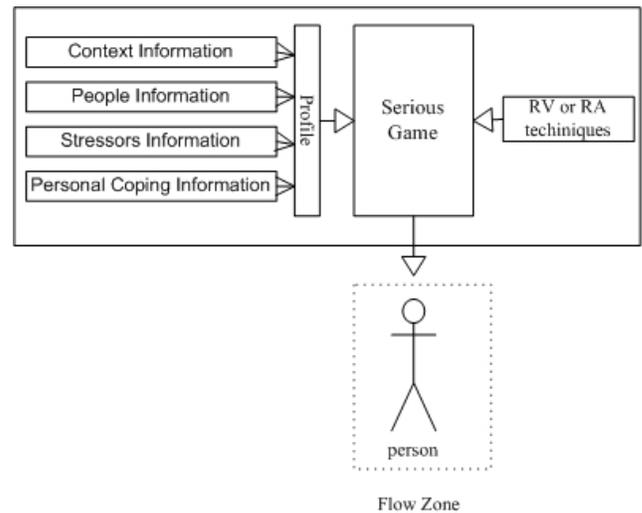


Fig. 4. Issue to Guide the Construction of a Serious Games to Cope with Stress.

## 10. CONCLUSIONS

The use of games as an agent capable of reducing stress levels of a person is proven in several studies. However, concrete proposals that utilize systematically Serious Games associated Virtual and Augmented Reality techniques developed as the purpose of coping with stress in the workplace demand further investigation. The proposal described in this work, though still embryonic, aims to contribute to research on coping strategies to occupational stress using Serious Game.

The proposed schemes in Figure 3 and Figure 4 present, in high level, the information necessary to develop the Serious Games as a tool to coping occupational stress. An interface, Employee Monitoring, is suggest to help the identification of the moment when is necessary an intervention to decrease the employee stress level.

This scheme needs to be validated and tested to verify their effectiveness and efficiency. Nevertheless, it is expected that the development of Serious Games oriented by inventory coping strategies using Virtual/Augmented Reality techniques,

with the purpose of coping can make them even more efficient as support tools for coping with occupational stress.

## 11. ACKNOWLEDGMENTS

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